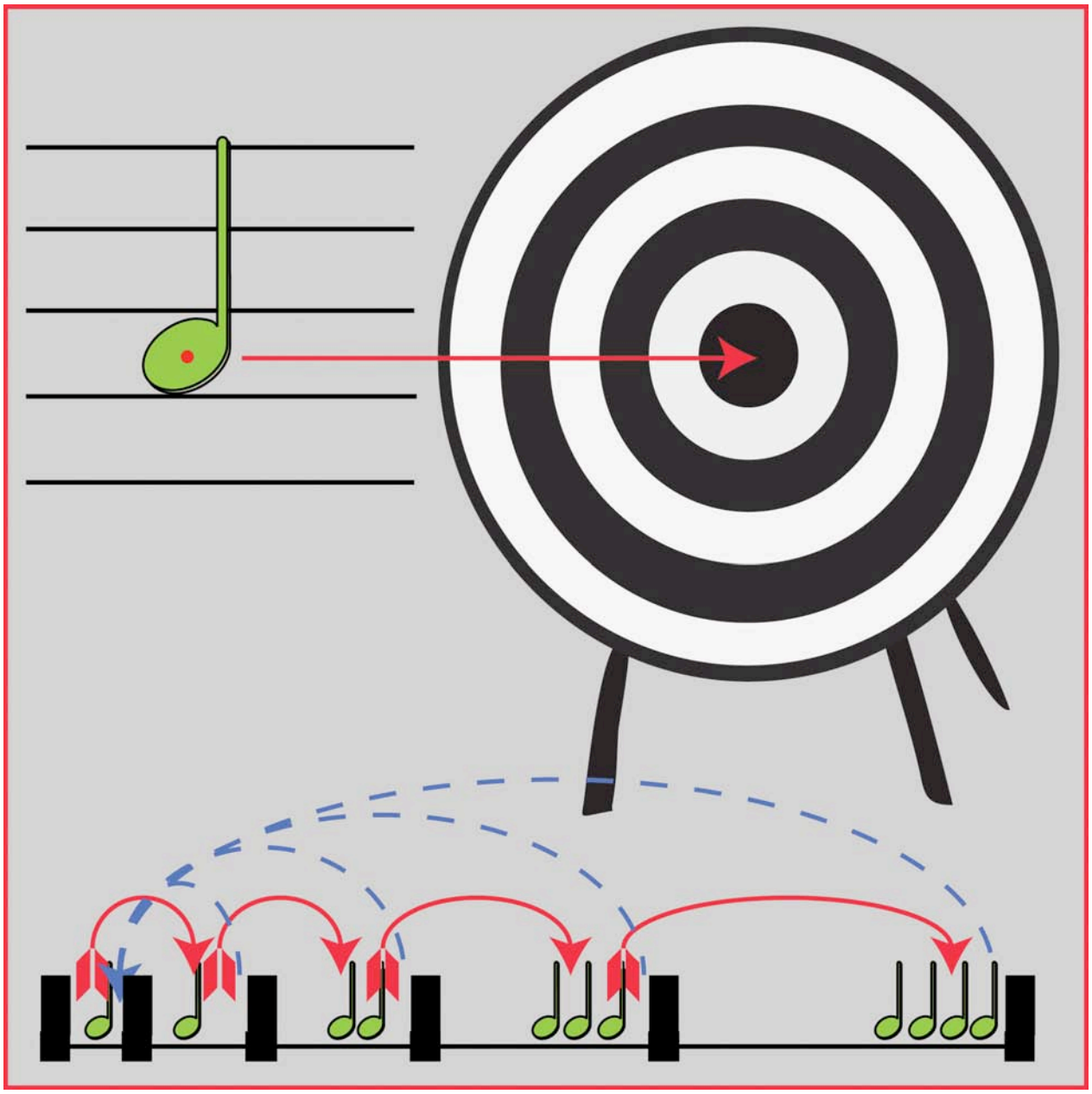

Listening Ear Trainer

User's Manual (v1.05 – Sep 2014)

www.AlgorithmsAndDataStructures.com, F. Rudin

Listening Ear Trainer

User's Manual

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Welcome to Listening Ear Trainer (LET)

Listening Ear Trainer is a software that helps you to improve your listening skills. Both Absolute and Relative Pitch skills will be covered with our unique methods that are explained below, so you can know what to expect. The free trial lets you estimate the amount of effort you have to put into the training in order to achieve, for instance, absolute pitch with the Singing Funnel Method. Our method measures the deviation from the target pitch in cents. So, if you master an accuracy level of 75 cents for 18 different notes, you are not far away from attaining absolute pitch. To claim absolute pitch, you must be able to determine the pitches with a score of better than 50 cents.
We understand that for many users the effort to gain absolute pitch is not worth the time, and that relative pitch is sufficient for their needs. For relative pitch training a structured progressive method is included.

Our methods base the learning process for pitches and intervals on the same principles as learning a foreign language: Improve your skills by actively bolster sound associations with pitch names.

Absolute Pitch Trainings-Methods

Our methods will teach you to better differentiate sounds by their pitch. And thus you will learn to recognize musical notes by their name.

Note names and pitches

In music notation each note represents a specific pitch depending on its placement on the staff. In the equal temperament tuning system the pitches jump by a semitone, or half-step. The physics of sound may not be important for every learner to understand, but here's an explanation for those who are interested. The semitone is the frequency change from one note to the next nearest note, and is always the same: The frequency of the next note higher is always 1.059 times larger than the current note. Likewise the frequency of the note lower is always the current frequency divided by 1.059. The exact multiplying or dividing factor is the twelfth root of 2 which equals 1.05946309436…. In Western music the concert pitch A is defined to "swing" with a frequency of 440 Hz. Given this frequency and the multiplying factor all pitches of the other notes can be calculated. This gives us distinct different frequencies for each note name and octave. In the following table the frequencies for the notes C4 to C5 are listed:

Note name	Solfege syllable	Scale degree and function (C Major)	Frequency
C5	Do	1st (8th) - Tonic	523.25 Hz
B4	Ti	7th - Leading Tone or Subtonic	493.88 Hz
Bb4 / A#4	Te / Li	b7th / #6th	466.16 Hz
A4	La	6th - Submediant	440.00 Hz
Ab4 / G#4	Le / Si	b6th / #5th	415.30 Hz
G4	So	5th - Dominant	392.00 Hz
Gb4 / F#4	Se / Fi	b5th / #4th	369.99 Hz
F4	Fa	4th - Subdominant	349.23 Hz
E4	Re	3rd - Mediant	329.63 Hz
Eb4 / D#4	Me / Ri	b3rd /#2nd	311.13 Hz
D4	Re	2nd - Supertonic	293.67 Hz
Db4 / C#4	Ra / Di	b2nd / #1st	277.18 Hz
C4	Do	1st - Tonic	261.63 Hz

Minimum pitch precision to differentiate notes

Now, to train your ear to recognize those frequencies is not easy. Since instruments are constantly exposed to physical environmental change, you seldom find those that are perfectly tuned. Most instruments have to be retuned if the temperature changes. Therefore the goal is to get a feeling for the acceptable range for each note. The narrower this range is the better you can differentiate notes. The deviation of the pitch from the perfect pitch is expressed with the unit cents. A deviation of 100 cents means, you are off by a semitone (or half-step). Therefore, you have to determine the frequency to at least 50 cents in order to assign pitch to the correct note name.

The overwhelming diversity of pitch

A trumpet, a piano or a violin may all play the same pitch. Yet they all sound different. Even two of the same instrument differ in sound: They all have their characteristic fingerprint. This circumstance makes it difficult to simply make an ear-training program. What should the ear-training program cover? Is it important to recognize the pitches of all instruments? Do you have to recognize very low and very high pitches too? What about loudness and duration of sounds? There are so many variations of pitch that it becomes difficult to define the goal of ear training.

Ear training is often associated with the question: Do you have perfect pitch? Therefore, our simple common goal is, to improve the ability to come closer to an absolute ear. Now often the term “perfect pitch” is used instead of absolute pitch. The word “perfect” makes you believe that you must answer “yes” to all the questions in the first paragraph. But that is not true if you take a test, you are usually allowed to answer a certain amount of questions incorrectly and still you can pass. Therefore do not let yourself be discouraged by the word “perfect.” The term “perfect pitch” should be used when somebody can produce a pitch that fulfills specific criteria: If you hear somebody who is in perfect harmony with the accompaniment, you may say, he/she is perfectly on pitch. Even so when the arrangement is tuned to the note A4 to swing with 444 Hz instead of 440 Hz you are still in perfect harmony when you have tuned your instrument also to 444 Hz for the note A4. For the recognition process we use the term “absolute pitch” since this categorization – connecting a pitch to a note name – is based on absolute pitches (e. g. The frequency for the note A4 is 440 Hz).

For the learning process it is very important to be allowed to make errors and not to worry about the whole complexity of learning and achieving your goal. That is, we have to reduce the diversity and begin with a limited range. Therefore our programs will teach you how to obtain the necessary skills in order to recognize absolute pitch. Thus we make the process for you as easy as possible: We use only one instrument, the maximum trained range is 18 notes (or one and a half octaves), and the sounds have no dynamics and are of a long duration. Of course, you can change these parameters if you like. However, do not underestimate the importance of our approach that lets you get acquainted to learning the recognition process itself. If you pass these simple exercises, you can be proud to say: “I have absolute pitch!” Even so, your knowledge is limited to a small range and only one instrument.

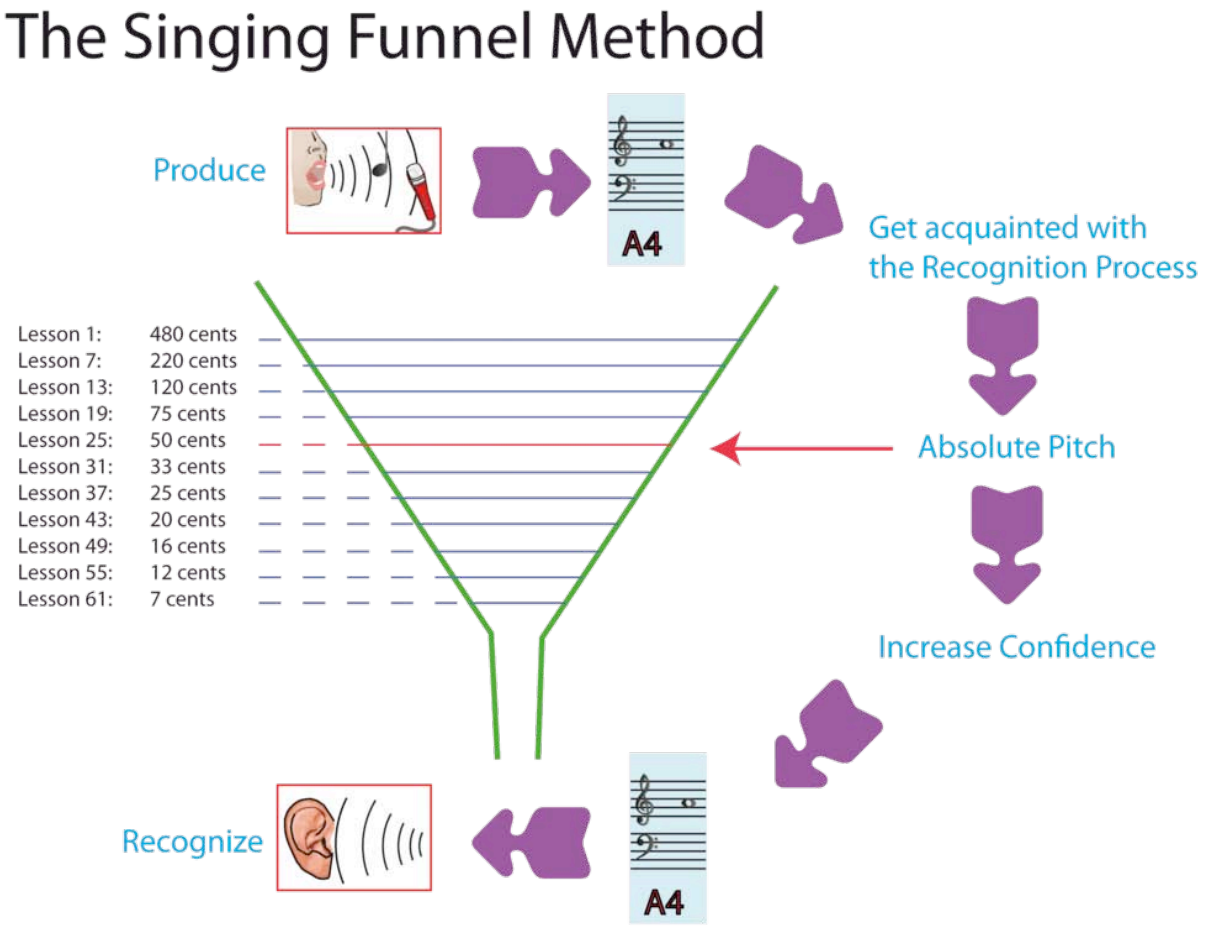
Both of our methods presented here will track your progress. The first method, the Singing Funnel Method, which takes the indirect method of producing a sound to improve your recognition skill, is very effective: It supports the process of building an “inner ear.” That is the program listens to you and therefore can guide you into the right direction. This instruction will show you the necessary steps to learn: How to produce, memorize and recognize pitches.

The second method, the Octave Anchor Pitches Method, gives you confidence that you indeed can recognize notes. In the beginning there will be only a few notes that are an octave apart. The process of adding other notes is not random; it builds on the overtones. At the first glance, it would seem easier to add the tritone that lies in the middle of the octave, since this would be the tone with the greatest distance to the already learned notes. But the process is to learn to differentiate similarities. Therefore we should first learn to distinguish the strongest overtone from our first notes. As we add notes based on overtone strength, we will start to make errors. Therefore, we have to go back and reassure ourselves that we can still recognize the previous

notes with ease. And yes, you will see that this is possible. In this way you make progress by building on previous learned knowledge. The tracking of your progress is the most effective way to learn: We will get feedback that you have understood the subject.

The Singing Funnel Method

Listening Ear Trainer helps you to sharpen your ear. One method we use we call the Singing Funnel Method:



The association of pitches to solmization syllables (Do, Re, Mi, ...) speeds up the calibration process of the ear.

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The program starts with recognition exercises that accept a large tolerance. That is to pass the first level you may be off more than two whole notes and still will be evaluated correct. In this way you get acquainted to the recognition process. With each lesson the tolerance range gets smaller. Therefore as you go from lesson to lesson your confidence will increase that you can hit the notes with a smaller tolerance. You will also know when a heard pitch meets the requirement that the frequency is near enough to the defined absolute frequency, and therefore the pitch can be assigned that particular note name. The important part of the learning process is to go through the

stages of narrower ranges. In this way you learn to hear and get a feeling for the deviation in cents. That is, for example, you can say the organ is 20 cents or 33 cents off the perfect frequency. If you have to accompany the organ with an instrument, you cannot change the tuning of the organ, but you can tune your instrument to the pitches of the organ. Important: You cannot do this with your perfect tuned pitchfork because you have to listen to the organ and tune your instrument so that the pitches of the organ and your instrument match and harmonize to each other. This ability is called "relative pitch recognition" since you tune your instrument relative to the organ. As you can see, the key to ear training is to improve your listening skills, so that you can recognize small pitch differences. The term relative pitch is generally used to describe the ability to recognize a pitch of a sound relative to another note. That is, you can name the distance – or in musical terms the interval – from one note to the next. To increase your ability to recognize small pitch differences, as described with the example of the organ, you must go beyond interval recognition. To gain this ability you have to do exercises, which will train your ear to hear smaller differences than 50 cents. A good way to do this is to strive for absolute pitch. Listening Ear Trainer's exercises will sharpen your ear and at the same time give you a feel for where the absolute pitches for the defined notes are.

Listening Ear Trainer allows you to proceed at your own pace. Listening Ear Trainer is always ready for an exercise, never gets bored and gives neutral feedback on what he has heard.

Learning to recognize pitches through singing by using muscle memory

Most people missed the chance to develop the ear for musical terms during childhood. Therefore the program returns you back to the situation when you learned to listen and utter sounds the way you wanted. That is your ears controlled the outcome from your adjustments of your vocal cords. Your brain learned what actions were necessary to change the outcoming sound in a desired direction. We are going to do the same process again: With our visual feedback measured to the cent, you will learn to control your voice with much greater precision.

But how do you remember pitches? By remembering the adjustments of your vocal cords. You think this is not possible? You might also be shocked and say, "me and sing?" How should I be able to control my vocal cords? Think again: First say "Ah." Now, say "Oh." Any clues on how you adjusted your vocal cords? Not the slightest! You could do it without any awareness of how you had to adjust your vocal cords. Yet, you must adjust your vocal cords precisely in order that a specific sound comes out your mouth. That is, you use your muscle memory to bring your vocal cords in a position, so that it can produce the fine differences between an "Ah" and an "Oh." The same is true for pitches: After a while you will not need to actively control your muscles of your vocal cords: It will come automatically. You will not even have to physically utter the sound: You will hear it during the preparation phase with your "inner ear." This is the perfect storage place for pitches: When you listen to a sound, just try to repeat the sound with your "inner ear" and prepare yourself mentally to repeat the sound. The brain will remember and recognize the vocal cords muscle positions and give you the necessary feedback to identify the pitch and name the note. Since you know how to say "Ah" you also know how to recognize the sound "Ah." How do you recognize a sentence from a bad recording? By re-listening and probably whispering the sounds of the sentence again, thereby looking for a possible match. The active speaking (whispering) helps you better focus on the recognition process. With Listening Ear Trainer your listening and recognizing skills should get better because you are repeating the learning sounds

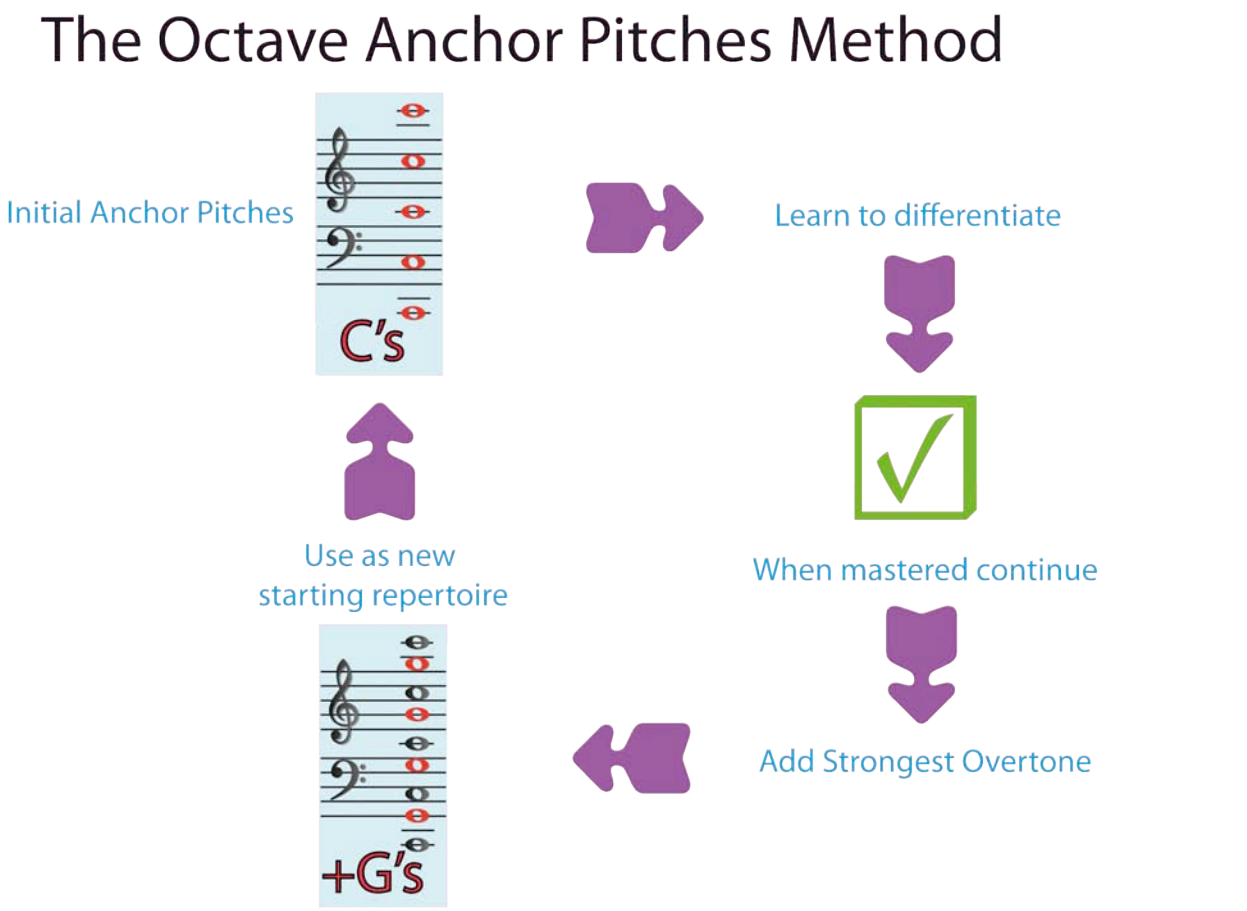
experience of your childhood: You will learn to control your vocal cords in order to change the outcoming sound in a desired direction. The visual feedback makes it easy to see the direction you are heading. If you are familiar with the process of how to increase or decrease your pitch, it is just a matter of training until you can do small and precise increments or decrements of a frequency to reach a desired frequency.

It may seem odd to learn to sing precisely in order to improve your listening skills. But as a child you do just that: You listen to the effects of your efforts to change your outcoming sounds. This actively acquired knowledge helps you to identify vowels and consonants. When you are born, you do not identify a sound just by listening: There is no pattern stored in your brain to recognize, for example, “Ah.” You have to actively experience it. And uttering the sound is a big part of that process. So Listening Ear Trainer encourages you to use the singing method to improve your absolute pitch abilities.

The Octave Anchor Pitches Method

Learn to identify pitches by adding notes to a small repertoire.

Since it is unlikely that you have a vocal range of 4 octaves, Listening Ear Trainer also includes a part where you do not have to sing. In these exercises you learn to distinguish notes spaced widely apart and then with each lesson you add more notes, so you have to listen closer to give a correct answer. The first exercise “Recognize the Cs” contains only the notes C2, C3, C4, C5 and C6. These notes are a whole octave apart and should be easily identified.


The Octave Anchor Pitches
Initial Anchor Pitches
C's
Learn to differentiate
When mastered continue
Add Strongest Overtone
Use as new
starting repertoire
+G's
The first overtone to add to your repertoire of the C's is a perfect fifth: The G. Followed by the inverted interval the perfect fourth: The F.
It is advised that you learn to differentiate the strong related pitches first. Other notes may seem more distinct and easier to separate.
However, it will be more confusing later, since more relationships to other notes exist and the specific characteristics start to blur.
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In the next exercise "Adding the Gs" the note G is added. As the dominant overtone of C, i.e., G's frequency is already contained as an overtone of C. Thus it is important that you learn to distinguish Gs from Cs before you continue.

The next exercise "Adding the Fs" will add the perfect fourth, the F. If you sound a G, which is a perfect fifth above the note C, then the inverted quality, the perfect fourth (or F in this case) will also sound as an overtone. Therefore, it is the best to learn to distinguish Fs from Gs and Cs before you continue.

The exercises continue by adding more notes. If you start to mix notes, it is recommended that you go back to a level where you know you can identify the notes correctly. Once you have found the level you have mastered, go forward again and concentrate on the characteristics of the newly added notes.

This method may not work for everyone; as some people may be able to hear the characteristics only for the instruments they train with. The singing method is more applicable universally, since one more easily transfers the pitch of one's instrument to one's voice, thus obtaining aural independence from the instrument.

Listening Ear Trainer's ultimate goal is for you to acquire a feeling for individual pitches. Accordingly it will foster absolute pitch. Although gaining absolute pitch cannot be guaranteed fully, if you make progress towards your ear-training goal, the products will have fulfilled their purpose.

What is new in our methods?

Our method has a few unique strategies:
First, we remove the mystique around perfect pitch. As explained above, perfect pitch has many faces: There is no one who can determine a frequency to an arbitrary precision. Let alone the whole spectrum from the lowest to the highest sounds. So nobody is perfect, but there is a definition for the absolute pitch frequencies (e. g. A4 has a frequency of 440 Hz). And to claim absolute pitch you are allowed to deviate from the absolute specified pitch frequencies to a certain degree. Therefore, instead of using the word perfect it is better to speak of the deviations from the absolute pitches. Yes, absolute is precisely defined, but nobody expects you to hit or guess the frequency to perfection. Deviations are the norm for everybody. Our "Singing Funnel" method makes use of this flexible norm. Most ear trainings-methods will mark a sound, which deviates more than 50 cents from the defined frequency as an error. We allow you to start off with a much larger error. The "how to gain accuracy" is part of the method. As you go through the funnel (the exercises) the program will tell you which notes no more fulfill the requirements to pass that level and lets you train these notes with appropriate feedback. This way allows you to be proud of mastering a level; even so in "perfect pitch" terms you may be off more than two whole tones. We allow that on the road to your goal. The "Octave Anchor Pitches" method has a similar approach in the way that it starts with easy to distinguish far apart notes (an octave). You then close the gap(s) by adding notes that are closer together. Again be proud of each level you master, it is your road to successfully reach your goal: absolute pitch.
Second, we use a systematic approach. Our methods as described under the first point guide you from the broad ideas to the details. During this process you get acquainted with the learning process itself: How to differentiate pitches? How to recognize pitches? How to memorize pitches? The methods are organized similar to projects. The project goal is to attain absolute pitch. In achieving the goal you must pass important milestones (In our methods each exercise is a milestone) that lend confidence in developing your ear.

I. Singing Funnel Method: The milestones of the Singing Funnel Method are Precision and Consistency. Since you will allow yourself to make large errors, you will observe how your development occurs. Once you've begun consistent practice, you will always seek the tool required for the next milestone. In the statistics display provided in the method you will receive information for each note showing the defined absolute pitch frequency and your mean and variance for that note The mean frequency shows your precision (how close you are to the defined frequency) and the variance shows your consistency (how much you vary around your mean frequency). .

II. Octave Anchor Pitches Method: The milestones for the Octave Anchor Pitches Method are Confidence and Certainty. Since we allow a great deal of uncertainty, for instance, in the first exercise of the Anchor Pitches Method (the first milestone) you have to distinguish notes that are an octave apart. You will find that you can reach that goal with confidence, and from there proceed to the next milestone (exercise). By adding the most similar tones to the ones just

learned, you enlarge your repertoire gradually. If you find yourself not progressing to the goal of the exercise, go back one level to make sure you can confidently identify the notes of the lower level.

Third, prior to having enough computer power, it was not feasible to manually collect data for individual notes, and to calculate mean and standard deviations. Nor was it feasible to do the "bookkeeping" or scoringof identifying notes to track progress. Today's computerized collecting and analyzing of performances allows for a systematic progression, using statistics or "bookkeeping". Both Octave Anchor and Singing Funnel methods allow you to improve your ability—to recognize pitches and assign them the appropriate name—in a systematically guided way. We provide the tools to obtain the necessary feedback and track your progress.

Relative Pitch Trainings Method

With our relative pitch method you learn to listen for intervals. The main feature of an interval is its “relative” characteristic. For example for a Perfect Fifth the higher note is always 7 semitones higher relative to the lower note. If two sounds are played together then the interaction of the two sounds produce a new property: With the two pitch frequencies of the involved notes, we can build a ratio. For example for an Octave the ratio we get when we divide the pitch-frequency of the higher note by the pitch-frequency of the lower note is always 2:1. This new property forms the center of the recognition process. The absolute pitch-frequencies of the two involved notes vanish during the recognition process of relative note distances. The distance always can be expressed as a ratio or in musical terms as an interval.

Intervals and pitches

An interval describes the distance between any two notes. In our Western music the semitone (or half-step) is the smallest unit to describe the distance. In this way any two pitches separated by 7 half-steps (upwards or downwards) form the interval of a Perfect Fifth. The positions on the staff—and therefore the absolute pitch-frequencies of the involved notes—are irrelevant for the interval name.

Overview: Interval names

Number of semitones	Common Interval name	Abbrev.	Chromatic Interval name	Abbrev.	Frequency ratio High / low
12	Perfect octave	P8	Augmented seventh	A7	$\left(\sqrt[12]{2}\right)^{12} = 2.0000$
11	Major seventh	M7	Diminished octave	d8	$\left(\sqrt[12]{2}\right)^{11} = 1.8877$
10	Minor seventh	m7	Augmented sixth	A6	$\left(\sqrt[12]{2}\right)^{10} = 1.7818$
9	Major sixth	M6	Diminished seventh	d7	$\left(\sqrt[12]{2}\right)^{9} = 1.6818$
8	Minor sixth	m6	Augmented fifth	A5	$\left(\sqrt[12]{2}\right)^{8} = 1.5874$
7	Perfect fifth	P5	Diminished sixth	d6	$\left(\sqrt[12]{2}\right)^{7} = 1.4983$
6	Tritone	TT	Augmented fourth Diminished fifth	A4 d5	$\left(\sqrt[12]{2}\right)^{6} = 1.4142$
5	Perfect fourth	P4	Augmented third	A3	$\left(\sqrt[12]{2}\right)^{5} = 1.3348$
4	Major third	M3	Diminished fourth	d4	$\left(\sqrt[12]{2}\right)^{4} = 1.2599$
3	Minor third	m3	Augmented second	A2	$\left(\sqrt[12]{2}\right)^{3} = 1.1892$
2	Major second	M2	Diminished third	d3	$\left(\sqrt[12]{2}\right)^{2} = 1.1225$
1	Minor second	m2	Augmented unison	A1	$\left(\sqrt[12]{2}\right)^{1} = 1.0595$
0	Perfect unison	P1	Diminished second	d2	$\left(\sqrt[12]{2}\right)^{0} = 1.0000$

Learn to recognize Intervals by identifying similarities

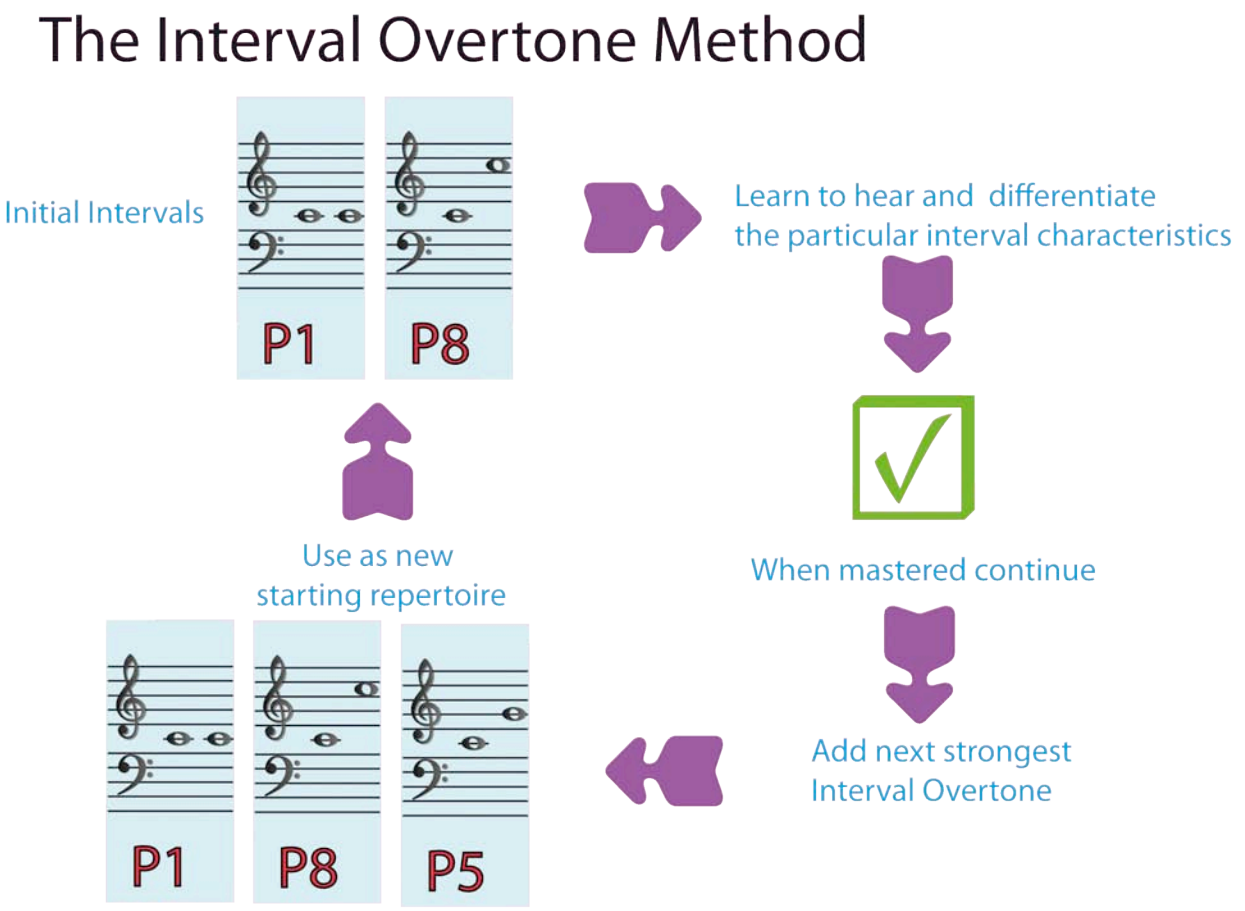
In contrast to recognizing individual pitches, recognizing intervals demands that you learn to recognize similarities between intervals starting from different notes. This may sound more complicated than recognizing individual pitches, but the brain learns to gather important information in listening to music. Thus, it can recognize the melody of a song independently of the starting pitch, i.e., you can sing it no matter the starting pitch. For example you will recognize the melody of "Silent Night" whether it's sung by children in high register or by a men's choir in a low one, and no matter what key—although certain keys will always be difficult if they fall outside the voice's comfort zone. Because relative pitch is a more necessary function in daily life,

the brain has learned to recognize relative deviations. You may not be able to name the interval, if you are not familiar with it, or trained to listen for the relationship between the two notes. But, as you might deduce from the "Silent Night" example, your brain has the necessary means to learn this skill. It recognizes the similarities of melody—i.e., the intervals—between different registers or instrumental and sung versions of "Silent Night," so all that is needed is the determination to learn to recognize intervals.

The Interval Overtone Method

We have found that to learn best a progress indicator is needed, in order for the student to recognize the goal approaching; and as a place of refuge, in case difficulties occur in achieving the goal. Thus our method starts with simple melodic, ascending intervals, continues with harmonic intervals, and finally introduces compound intervals.

Since the basic task is to learn to recognize similarities of two-note relationships, we progress from most similar tones to more complex sound patterns. For instance, in the Octave Anchor Pitch Method, we follow the overtones contained in a sound. However, since the inverted intervals are also present in the sound (since the first overtone, the octave, is always present), we learn—where appropriate—the inverted interval that comes before the overtone occurs. This deviation from the overtone series lends the Interval Overtone Method its name.


The Interval Overtone Method
Initial Intervals
P1
P8
Learn to hear and differentiate
the particular interval characteristics
When mastered continue
Add next strongest
Interval Overtone
Use as new
starting repertoire
P1
P8
P5
We start by learning to differentiate the unison from the octave. When we have mastered to hear the particular interval characteristics, we continue with the next most similar interval. It is advised that you learn to differentiate the strongest similarities first. Other intervals may seem more distinct and easier to separate. However, it will be more confusing later, since more relationships to other intervals exist and the specific characteristics start to blur.
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You will learn to recognize the Sequence of Intervals as follows:

- Perfect Unison – Perfect Octave
- Perfect Fifth
- Perfect Fourth
- Major Third
- Major Sixth
- Major Second
- Major Seventh
- The Minor Intervals

We recommend that you avoid skipping exercises. That way you can be sure you have mastered each interval. Then, in the next level, you only have to watch for the appearance of a new sound pattern. If you can distinguish all—up to now—learned patterns, you will know you have learned to differentiate the most similar sounds. The following sounds will have less in common with those intervals already presented.

It might be easier to distinguish the interval of a tritone from a unison or octave than to distinguish a perfect fifth from the same, since the tritone has a very dissonant sound – and therefore is easy to distinguish. We will continue our training with the perfect fifth, however, because the triton's very complex sonority contains all the other intervals as overtones to a certain degree. Hence it may make it more difficult to learn to differentiate other more similar intervals later, because they can be confused with the tritone, which also contains these characteristics. You should follow the order that has the least distractions, as it is easy to recognize the special property of a perfect fifth. Thus you can easily concentrate on the pure distinct differences between the unison, the octave and the perfect fifth. With the tritone it will be very difficult to hear a special property, since the special properties of other intervals are also present. In this way it makes sense to learn the special properties one by one, even if it is harder to distinguish in the beginning. Once you have mastered distinguishing the most similar intervals, you can upgrade your differentiation skills by adding a new interval with its unique characteristic. You will focus on learning the interval's characteristic until you can differentiate it from patterns learned before.

When you have succeeded to differentiate the eight simple intervals in melodic form, you are ready for harmonic intervals. It may seem easier to start with harmonic intervals, since both tones are played simultaneously, you can hear the physical relationship between the two sounds, and you don't have to build the interactions yourself as is the case by successively played notes. However, as a beginner, you may have no place to store that experience directly. It is therefore easier and more effective to learn to associate the beginning of a tune to a melodic interval. Once you are fluent in recognizing intervals, you no longer need to make the detour using a song to identify the interval, but you will have a fallback to anchor your newly acquired knowledge. This fallback provides the necessary confidence to proceed in the recognition process.

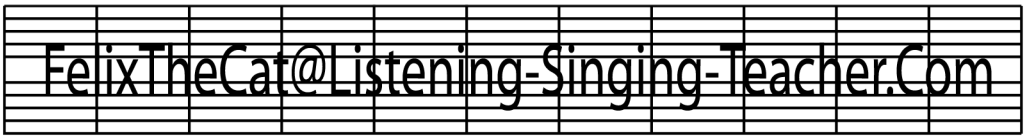
Finally, you can refine your skills by learning all twelve simple and compound intervals.

What is unique to this method?

Similar to our other methods introduced, this method uses a systematic approach (the order of the intervals to learn), milestones (the exercises) and bookkeeping (scoring) to observe your progress. (Incorrect answers bring the corresponding interval to the top of the learning process (repetition)). Similar to our Octave Anchor Pitches method, the Interval Overtone method steers directly toward the goal: to recognize the interval without a context, by means of recognizing "absolute" interval characteristics. By "absolute" we mean learning to isolate the different unique characteristics of each interval. So, no matter where the interval starts, the relationship between the two notes will always produce the same unique (or universal) pattern of interactions (the ratios) for a given distance of semitones). You learn the interval properties one by one. You learn new interval properties by excluding already learned interval properties. The scores measure how close you have grasped the pure interval characteristic: A score of zero means the interval is not mastered and will be repeated as a question often. As the score increases the interval will be asked less often. A score of 7 means you have mastered the interval. However, the more intervals are in the pool of mastered intervals, the greater the chances are that one of the mastered intervals is again posed. Of course if all intervals have a score of 7 (meaning they are in the pool of mastered intervals), you will be presented with one of those intervals.

Most other ear training methods start with minor and major seconds and do not encourage you to stay in a level until you have mastered the current level. For the Interval Overtone method it is important that you grasp the interval properties by their similarity: You have to learn to differentiate the strongest similarities first, since these properties are also contained (to some degree) in the following intervals. Thus, our method builds by starting a fundament for differentiation and expands this fundament by adding new differentiation properties. You learn "absolute interval" characteristics by differentiating them. In other methods you often have to decide for yourself what intervals you want to learn. We think beginners are overwhelmed with these choices and often choose to continue too fast. However, everyone is different, so other methods may be better suited for some people. The method's suitability also depends on your musical background. If you are fluent with chords, you may not want to use this systematic or "universal" interval characteristic approach and prefer to learn the intervals in a contextual approach. In our exercises you also have the standard option of choosing the intervals you would like to learn.

Contact

We hope you will spend many enjoying hours with Listening Ear Trainer. Your comments and inputs are most welcome: Please mail them to:

Installation Macintosh

Requirements

Before you begin, make sure that your computer is fast enough. To have a good performance a G4 with 1 GB of RAM and adequate graphic card is required. A Mac Mini G4 with 1.25 GHz and 1 GB of RAM, or later version will suffice. This program was tested with Mac OS X l0.4.11.

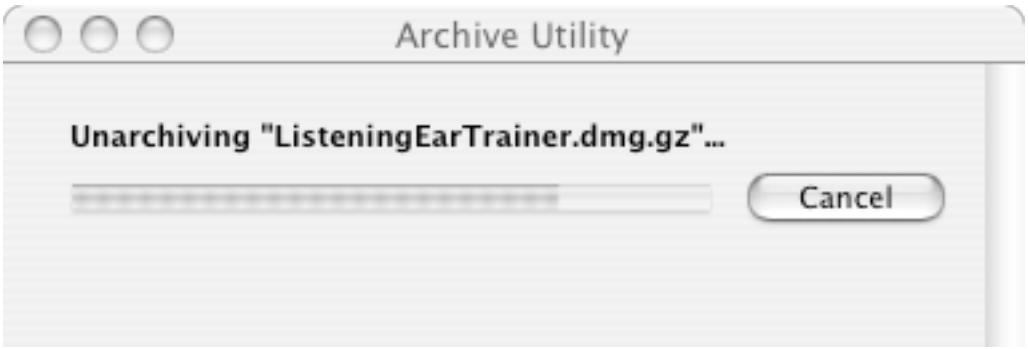
You must have an appropriate microphone connected to your computer. Check the relevant manuals on how to connect a microphone. A Mac Mini G4, for example, does not have a microphone input; you have to use additional hardware, like a computer-compatible USB device capable of handling microphone inputs. Important: A “line in” is not the same as a microphone input. If you do not have a microphone input you might need a pre-amplifier.

Getting and unpacking the disk image

The first step is to download the compressed disk-image-file. In your browser go to www.Listening-Ear-Trainer.com and download the newest version.

Warning: The file has about 120 MB and takes about 1/4 hour on a low-speed DSL line. After the download has completed you should see an icon on your desktop that looks like this:

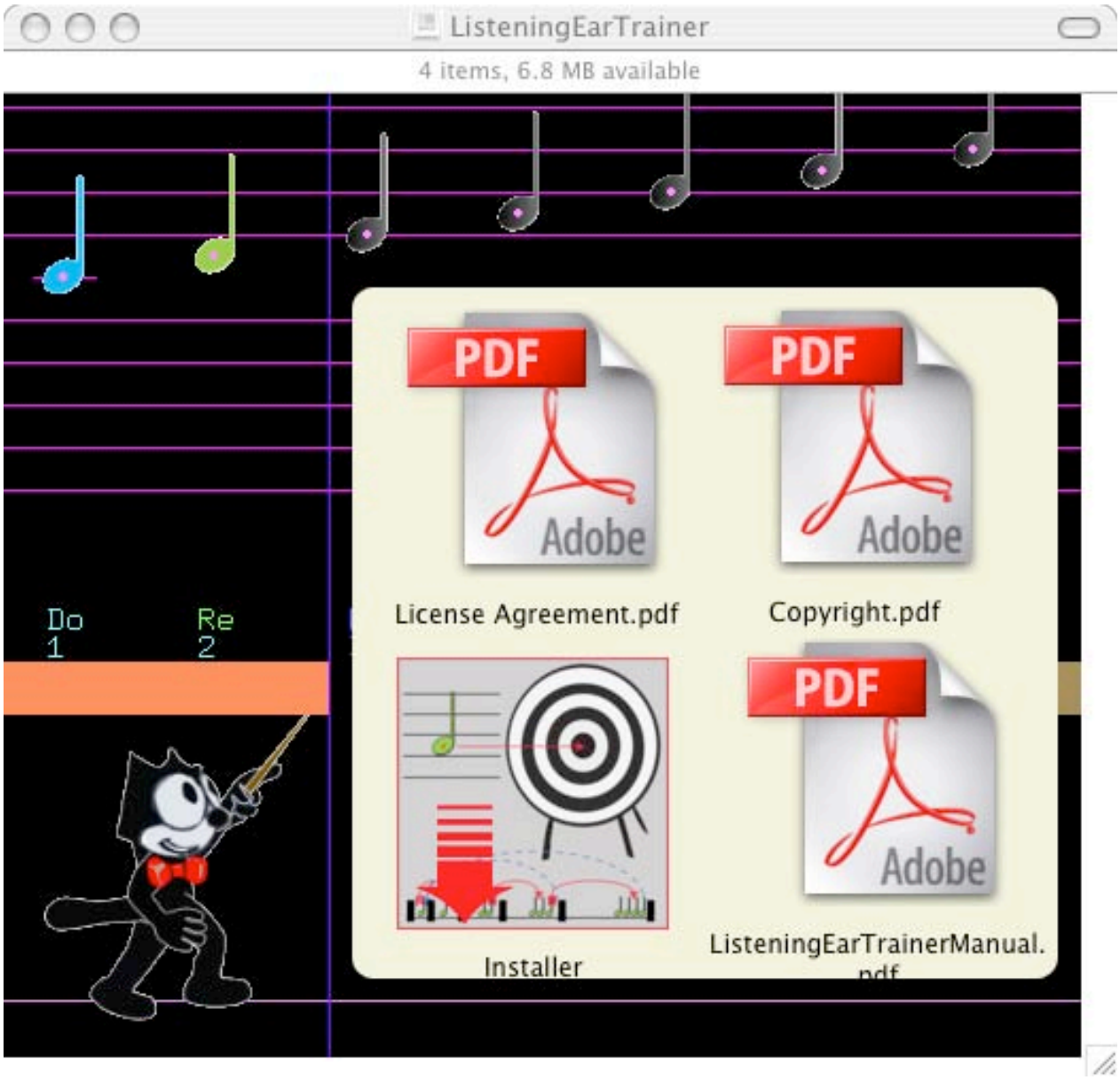
The second step is to decompress the file. Double-click on it: the archive Utility appears.



After this task finishes, double-click on the new icon that was created.

The Disk Image gets mounted. On the desktop you should see the following icon:

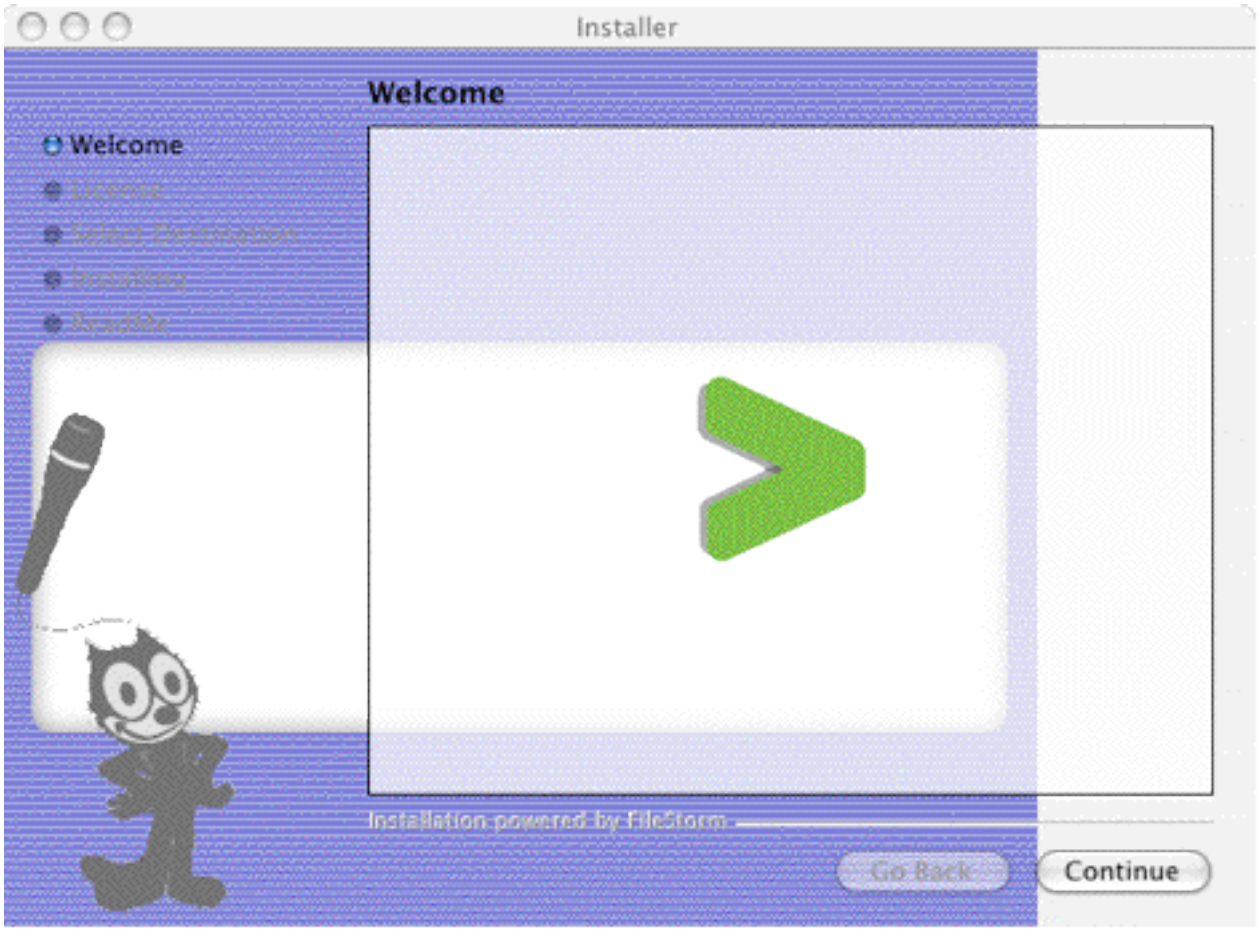
A double-click brings up the Installation window.


ListeningEarTrainer
4 items, 6.8 MB available
PDF
Adobe
License Agreement.pdf
PDF
Adobe
Copyright.pdf
Do
1
Re
2
Installer
PDF
Adobe
ListeningEarTrainerManual.
pdf

Installation

Read the License Agreement and the Copyright before installing. During the installation you must agree to the terms or discard the downloaded files.

Double-click the installer to begin. Before the Welcome screen appears a minute or so may elapse. The installer will guide you through the installation process.



If you used the defaults during the installation, Listening-Ear-Trainer should have been installed in your applications Folder.

Uninstalling Listening Ear Trainer

In the Finder click on Applications and drag the Icon for Listening Ear Trainer to the Trash.

Installation Windows

Requirements
Before you begin, you may want to make sure that your computer has enough RAM to power the program. To have a good performance an Intel core Duo with 1 GB of RAM and adequate graphic card is required. The program has been tested on Windows XP, Vista and Windows 7.

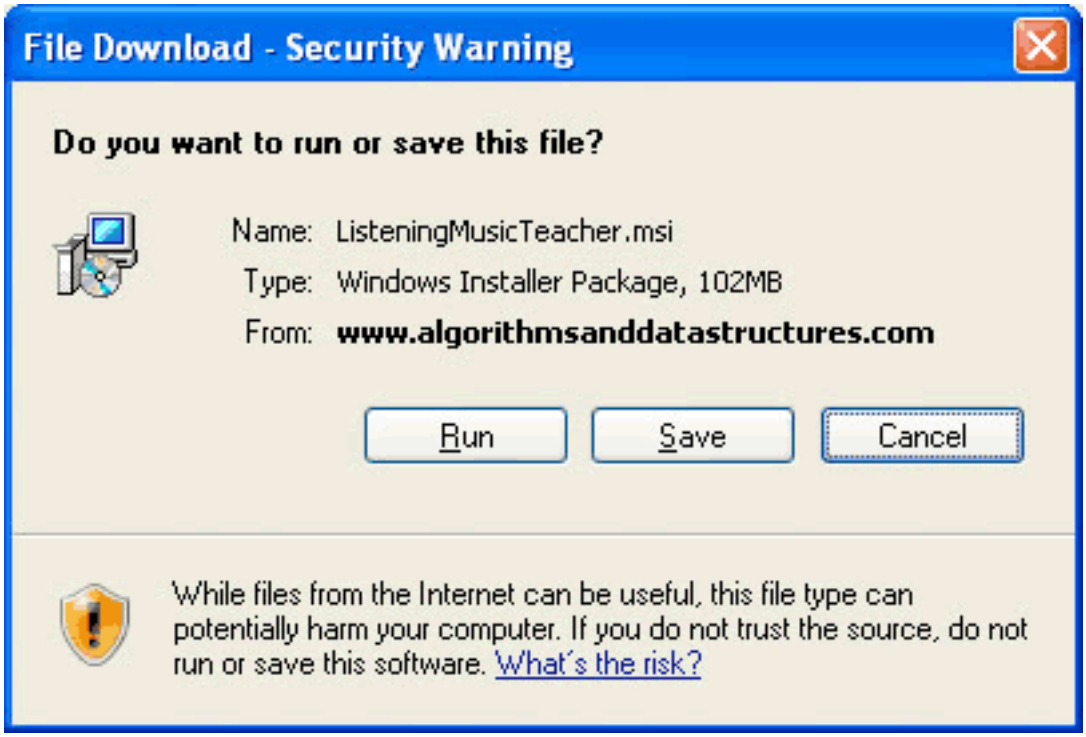
You also need QuickTime, which is downloadable.

You must have an appropriate microphone connected to your computer. Check the relevant manuals on how to connect a microphone to your computer. Some PC's do not have a microphone input; in which case you must use additional hardware, such as a computer compatible USB device capable of handling microphone inputs. Important: the "line in" is not the same as a microphone input. If you do not have a microphone input you will need a pre-amplifier.

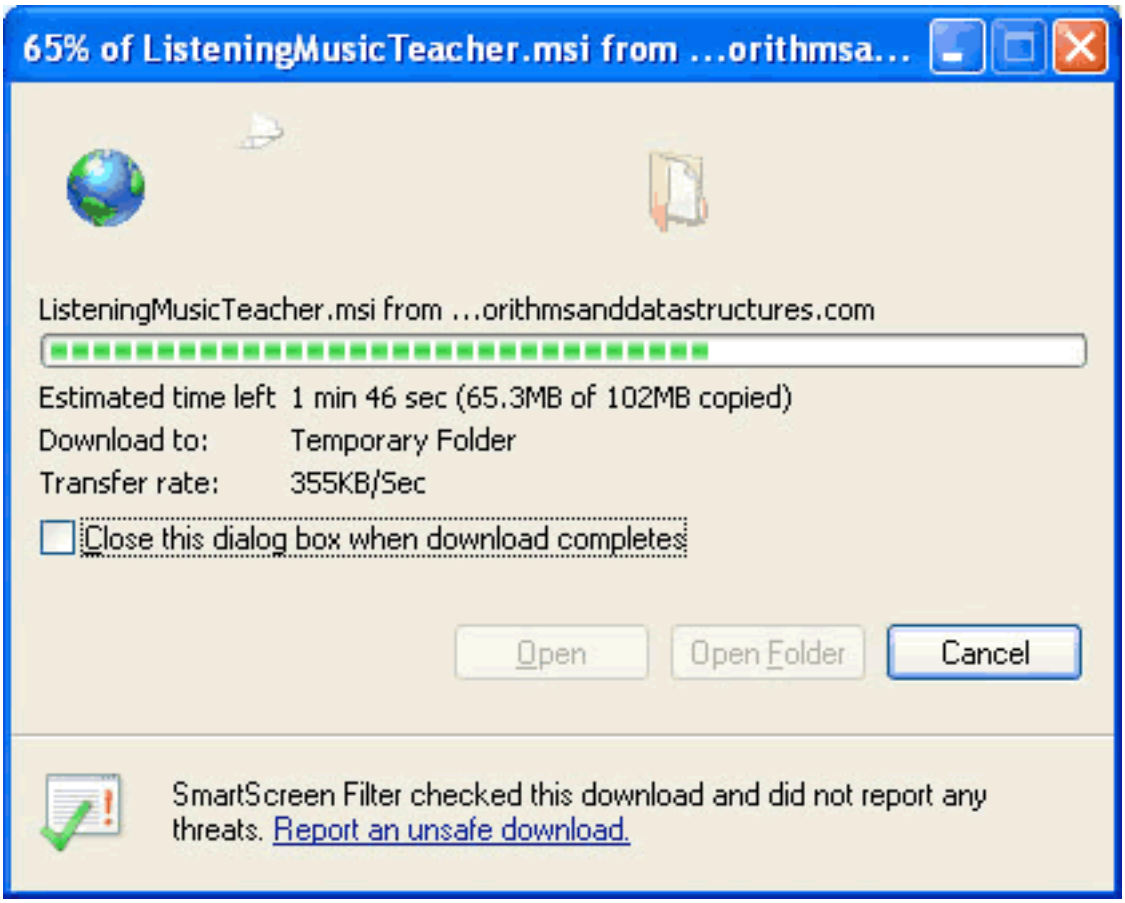
Getting the installation file
The first step is to download the compressed installation file (.msi). In your browser go to www.Listening-Ear-Tainer.com and download the actual version under the download-tab.

Warning: The file has about 120 MB; this will take about 1/4 hour on a low speed DSL line.

Installation
After clicking the download link the following window opens:


File Download - Security Warning
Do you want to run or save this file?
Name: ListeningMusicTeacher.msi
Type: Windows Installer Package, 102MB
From: www.algorithmsanddatastructures.com
Run
Save
Cancel
While files from the Internet can be useful, this file type can potentially harm your computer. If you do not trust the source, do not run or save this software. What's the risk?

Click "Run". The actual download starts.

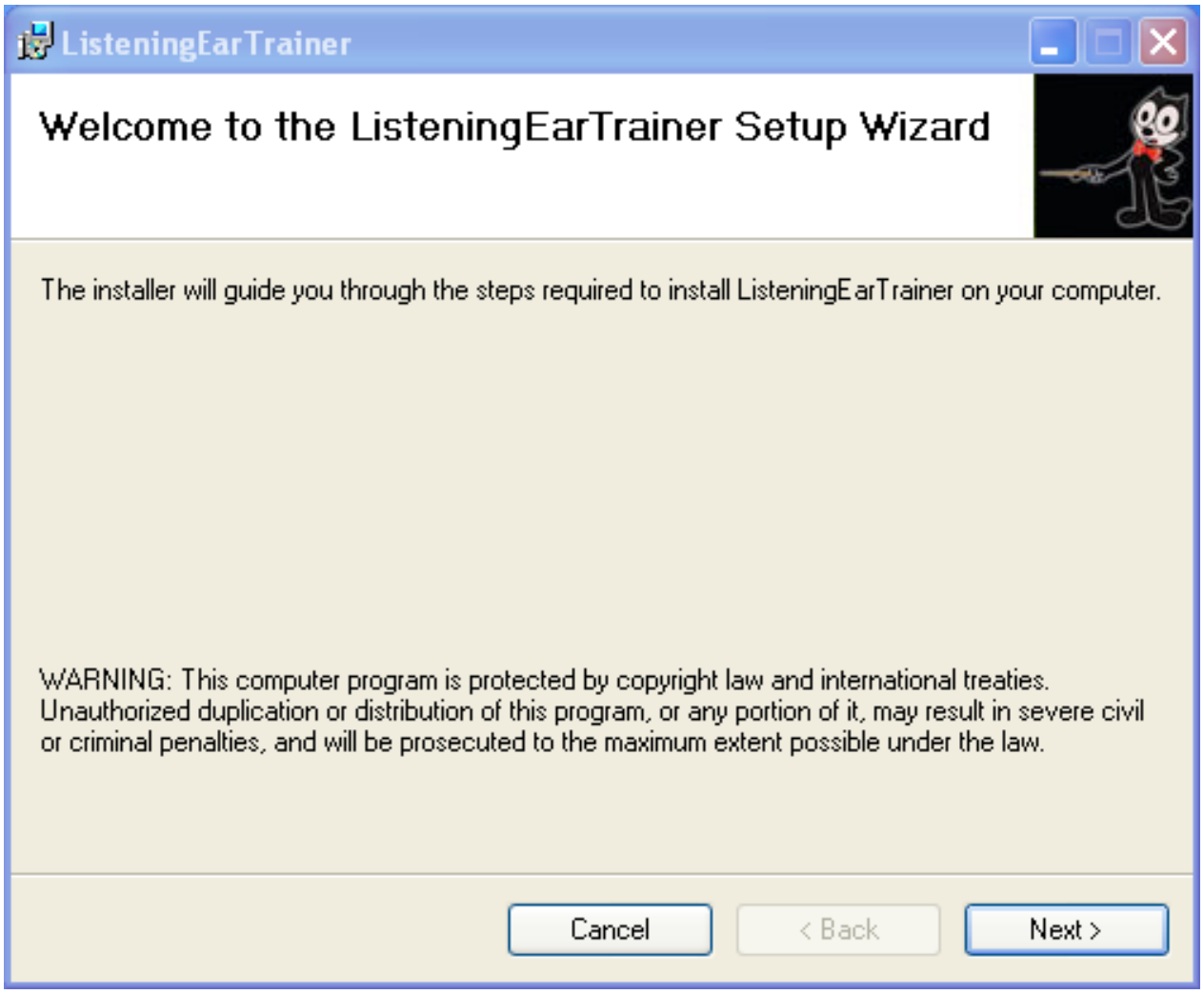

65% of ListeningMusicTeacher.msi from ...orithmsa...
ListeningMusicTeacher.msi from ...orithmsanddatastructures.com
Estimated time left 1 min 46 sec (65.3MB of 102MB copied)
Download to: Temporary Folder
Transfer rate: 355KB/Sec
Close this dialog box when download completes
Open
Open Folder
Cancel
SmartScreen Filter checked this download and did not report any threats. Report an unsafe download.

When the download finishes the following Security Warning appears:

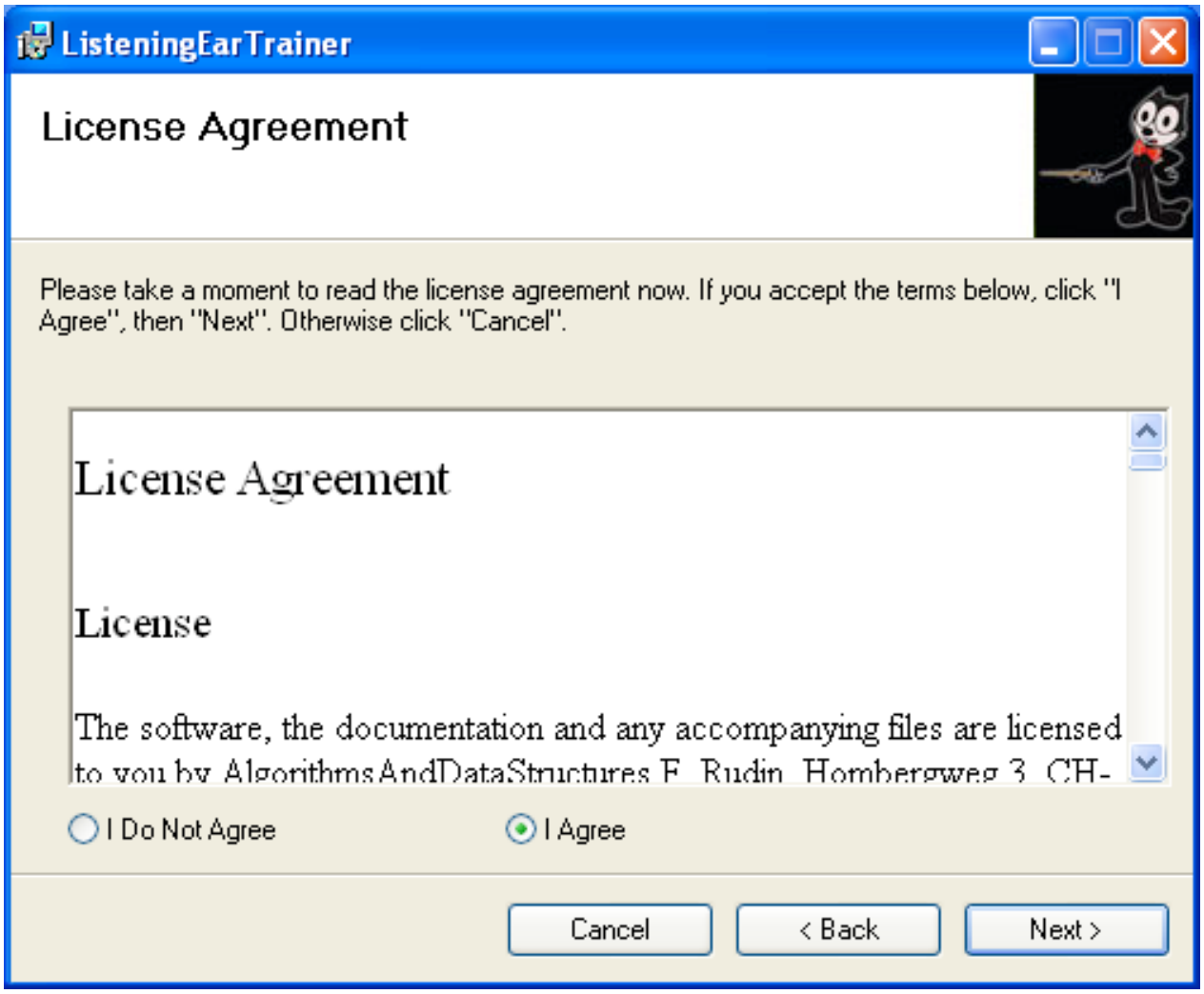
Internet Explorer - Security Warning
Do you want to run this software?
Name: ListeningMusicTeacher.msi
Publisher: AlgorithmsAndDatastructures, F. Rudin
More options
Run
Don't Run
While files from the Internet can be useful, this file type can potentially harm your computer. Only run software from publishers you trust. What's the risk?

If you do not click “Don’t Run,” click “Run” to continue the installation.

The Setup Wizard Window opens:

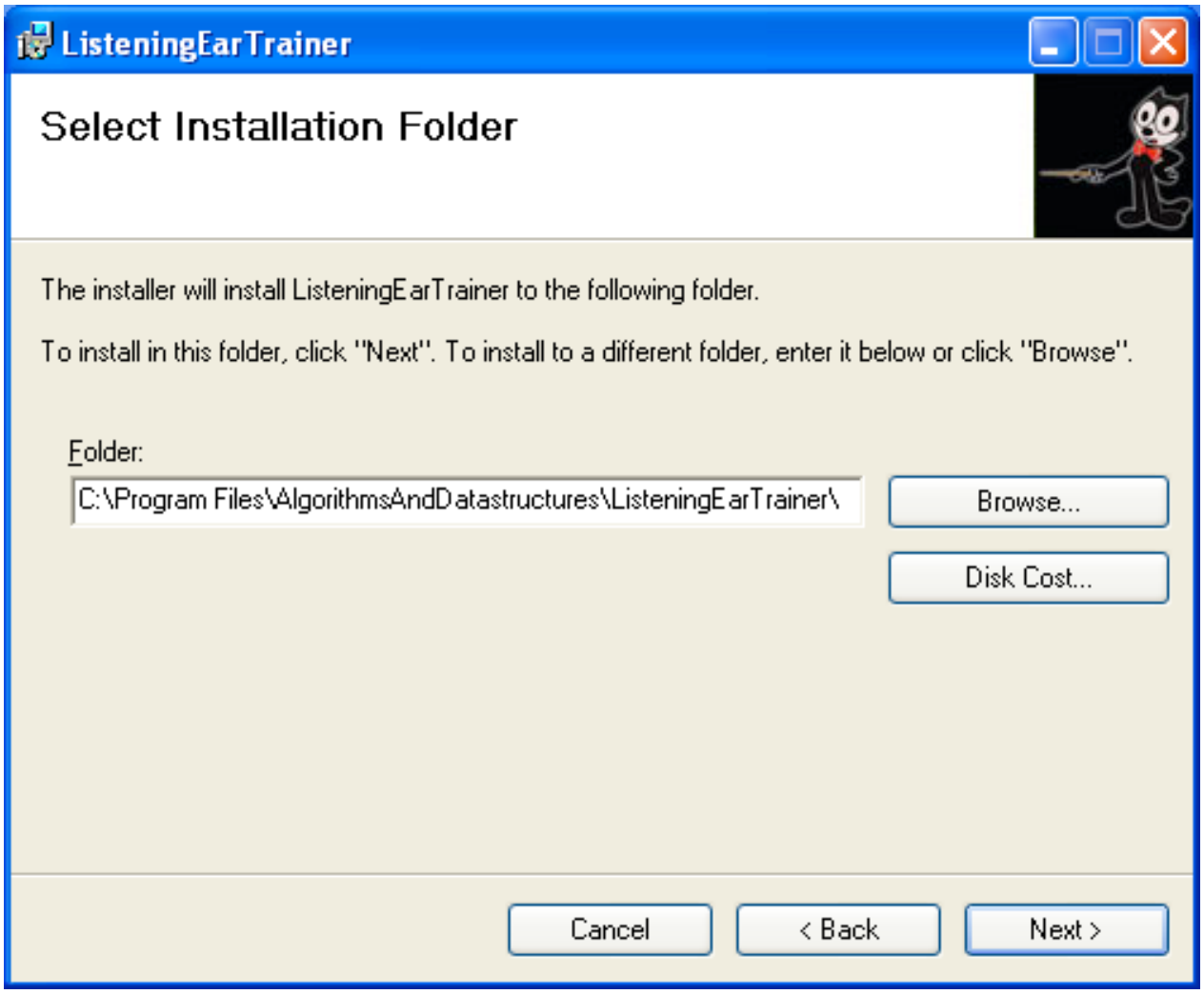

ListeningEarTrainer
Welcome to the ListeningEarTrainer Setup Wizard
The installer will guide you through the steps required to install ListeningEarTrainer on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

Click Next. The License Agreement appears.


ListeningEarTrainer
License Agreement
Please take a moment to read the license agreement now. If you accept the terms below, click "I Agree", then "Next". Otherwise click "Cancel".
License Agreement
License
The software, the documentation and any accompanying files are licensed
I Do Not Agree
I Agree
Cancel
< Back
Next >

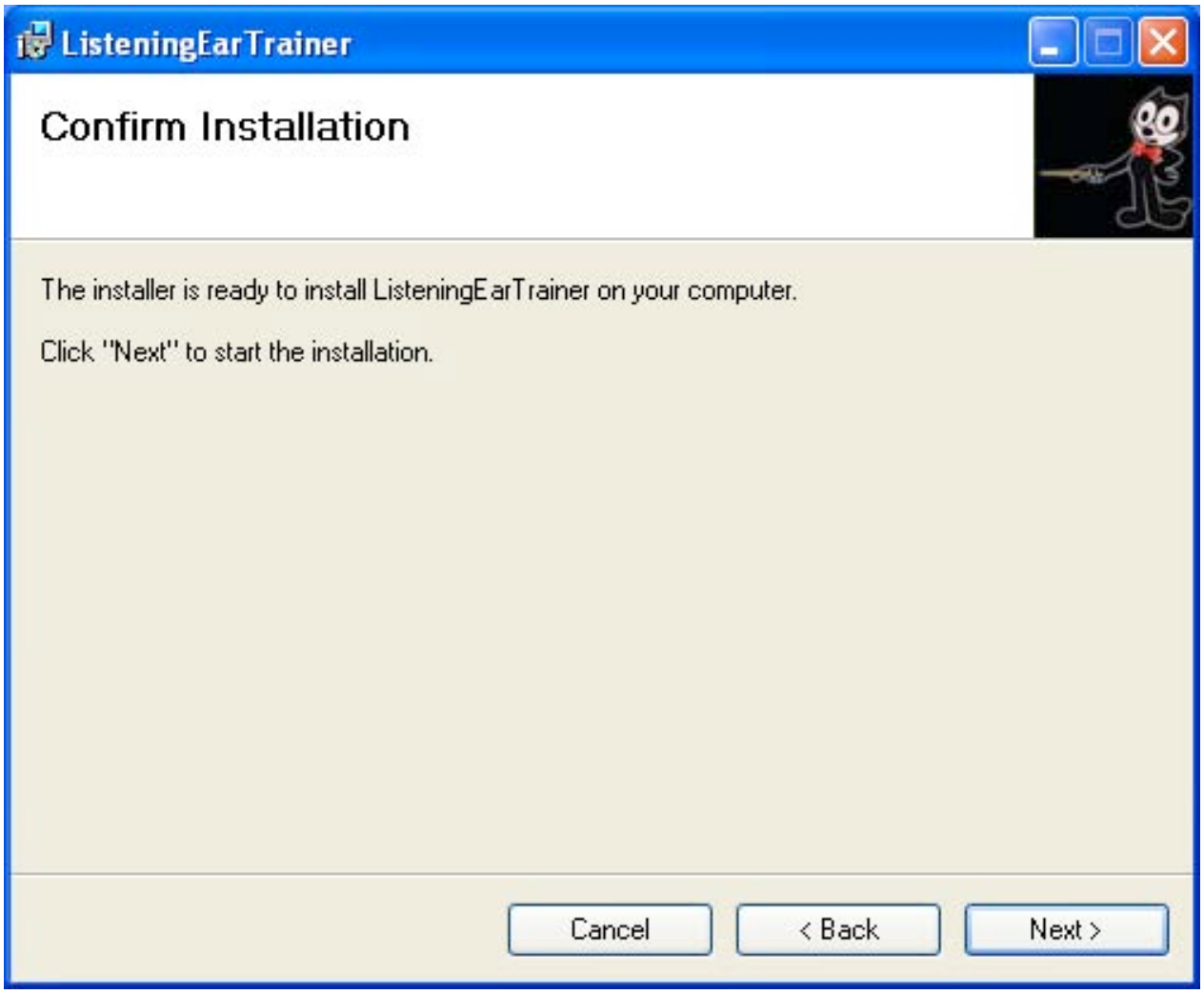
Read the License Agreement and the Copyright before installing. Click “I agree” if you agree with our License Agreement.

The “Select Installation Folder” dialog appears. By default the application will be installed under C:\Program Files\AlgorithmsAndDatastructures\ListeningEarTrainer.

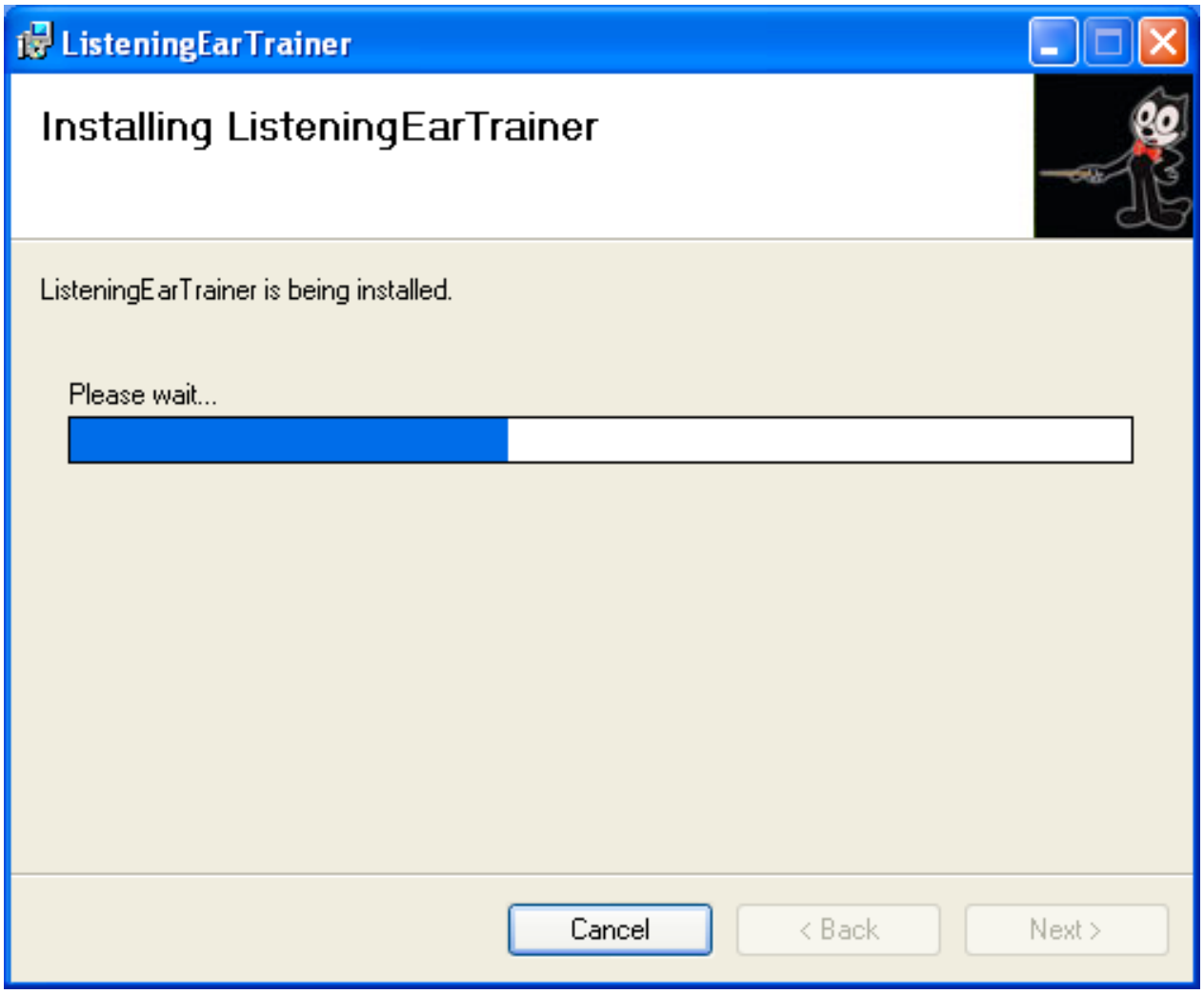

ListeningEarTrainer
Select Installation Folder
The installer will install ListeningEarTrainer to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Program Files\AlgorithmsAndDatastructures\ListeningEarTrainer\
Browse...
Disk Cost...
Cancel
< Back
Next >

Choose your folder location and click “Everyone,” so that persons with a separate login on your computer can also run the program.

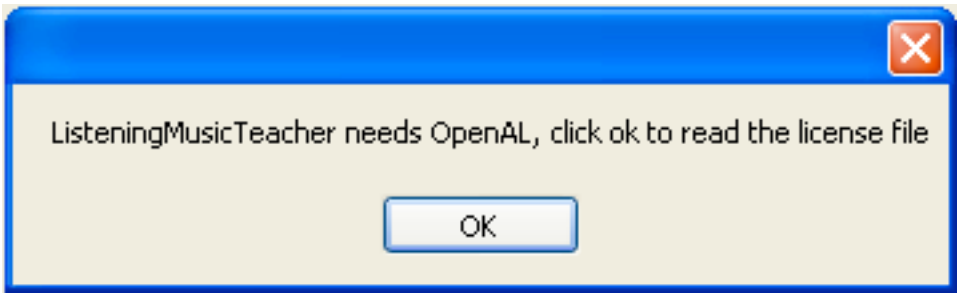
The confirmation Window appears:


ListeningEarTrainer
Confirm Installation
The installer is ready to install ListeningEarTrainer on your computer.
Click "Next" to start the installation.
Cancel
< Back
Next >

Click “Next” to start the Installation:



Listening Ear Trainer uses OpenAL for sound.

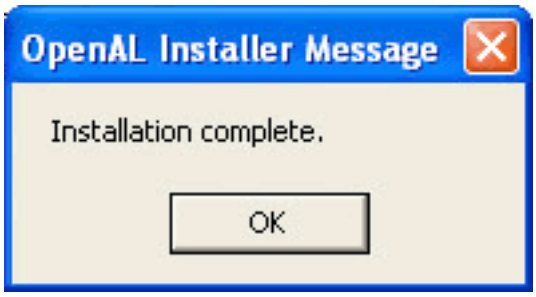


Click “Ok” and you will be presented with the OpenAL License Agreement:

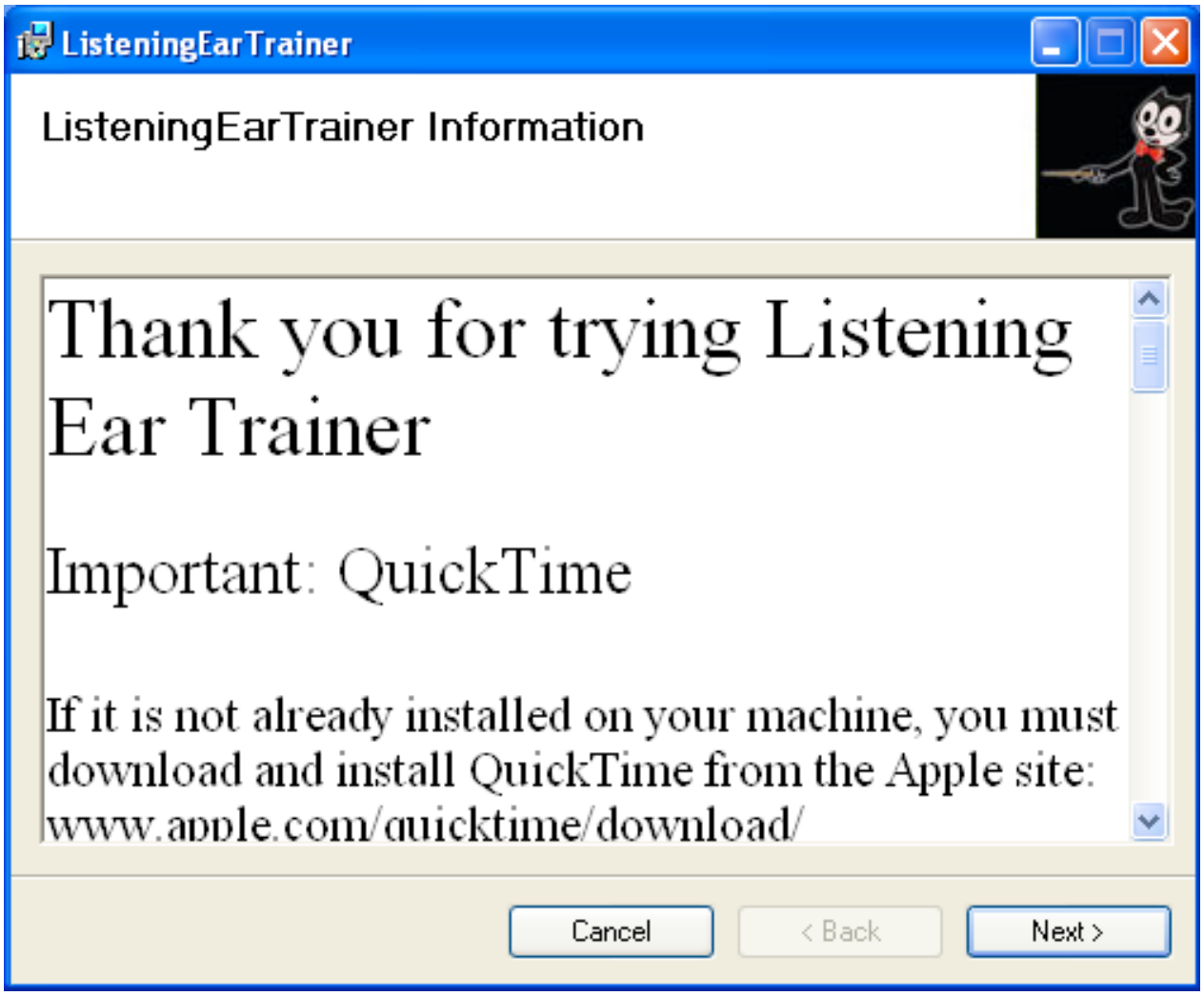
OpenAL Installer
License:
Creative Labs, Inc. is providing you with this OpenAL32.dll installer and other OpenAL files ("Software"). You may use and freely integrate with your software applications and distribute such throughout the world at no cost or further obligation to Creative.
NO WARRANTY
ANY USE BY YOU OF THE SOFTWARE IS AT YOUR OWN RISK. THE SOFTWARE IS PROVIDED FOR USE "AS IS" WITHOUT WARRANTY OF ANY KIND. TO THE MAXIMUM EXTENT PERMITTED BY LAW, CREATIVE DISCLAIMS ALL WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING,
Cancel
OK

Click “OK” if you not already have installed OpenAL.

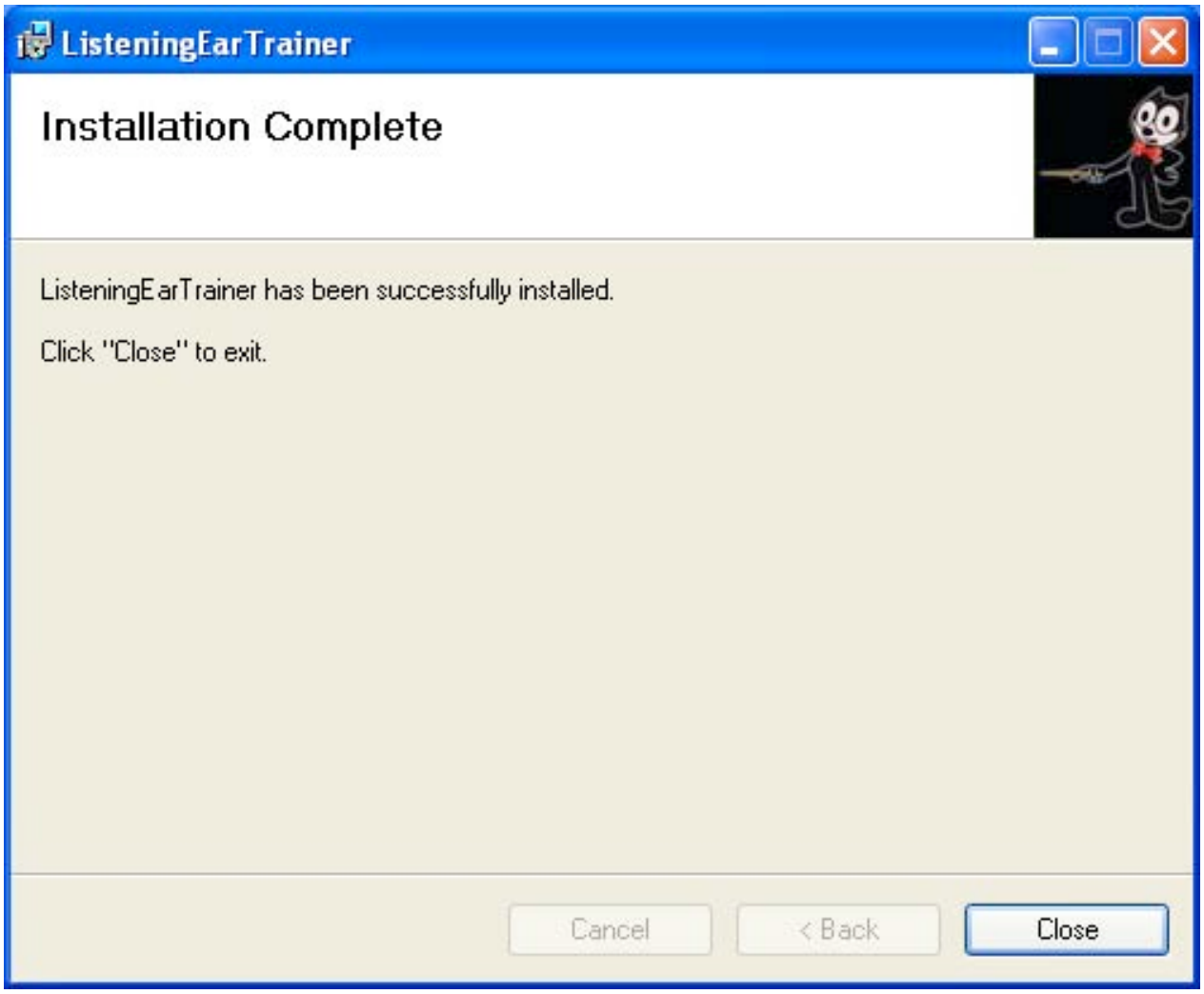
The OpenAL Installer informs you about the installation:



Finally, the installation is finished.


ListeningEarTrainer
ListeningEarTrainer Information
Thank you for trying Listening Ear Trainer
Important: QuickTime
If it is not already installed on your machine, you must download and install QuickTime from the Apple site:
www.apple.com/quicktime/download/
Cancel
< Back
Next >

Browse through the ReadMe file, and then click “Next.”



Click “Close.”

On the Desktop you should find a Shortcut to ListeningEarTrainer:

Uninstalling Listening Ear Trainer

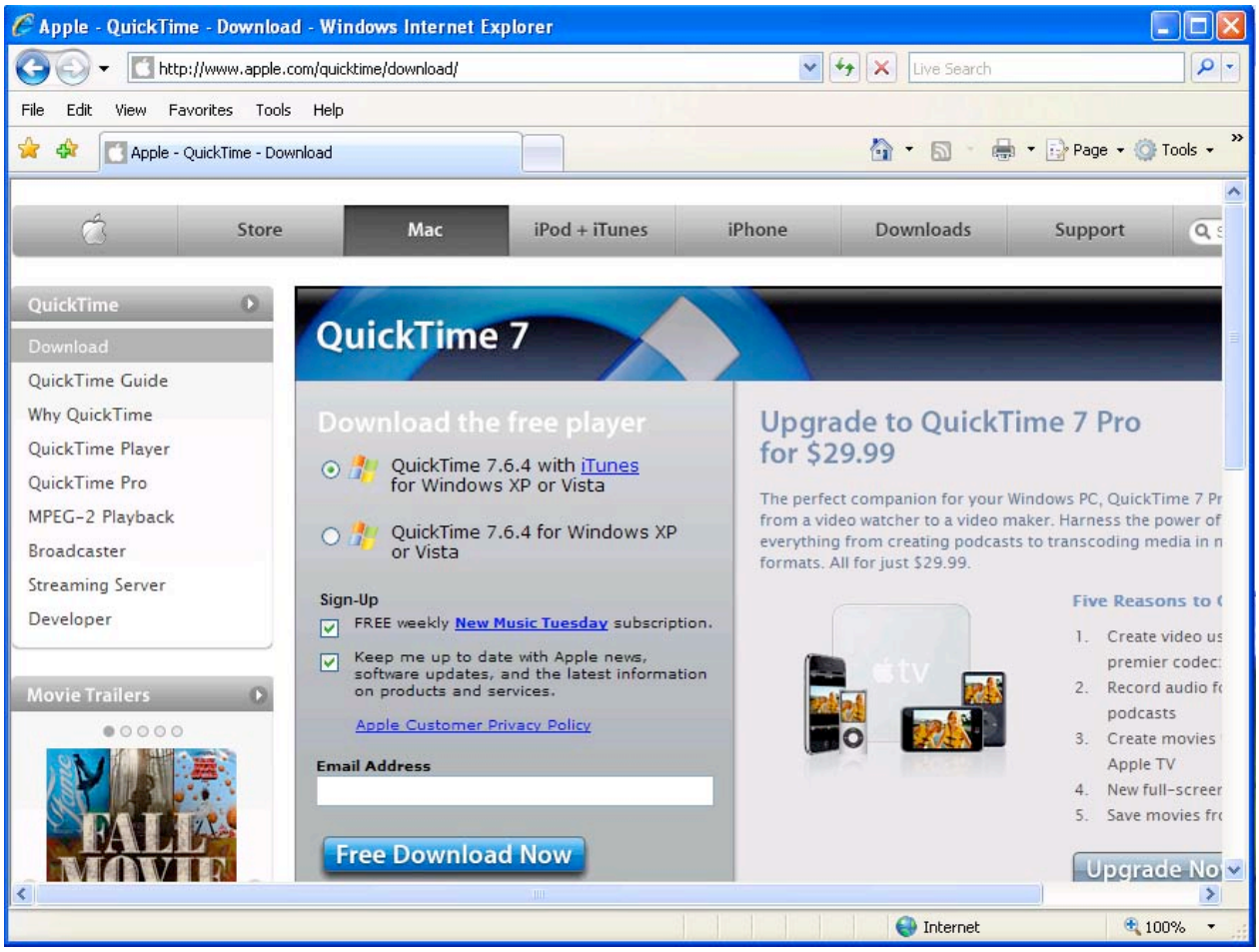
If you need to do so, use Uninstall from the Add/Remove Software Control Panel.

QuickTime

This software uses QuickTime from Apple Computer, Inc. On Macintosh computers this software is pre-installed, but on Windows QuickTime is not installed by default unless you have installed QuickTime or iTunes already, in which case you do not have to install QuickTime again. However it is always best for smooth running of the program to have the newest release.

You need Windows XP with Service Pack 2 or Windows Vista to be able to install QuickTime.

In the Internet Browser enter http://www.apple.com/quicktime/download. You should be presented with a page like this:

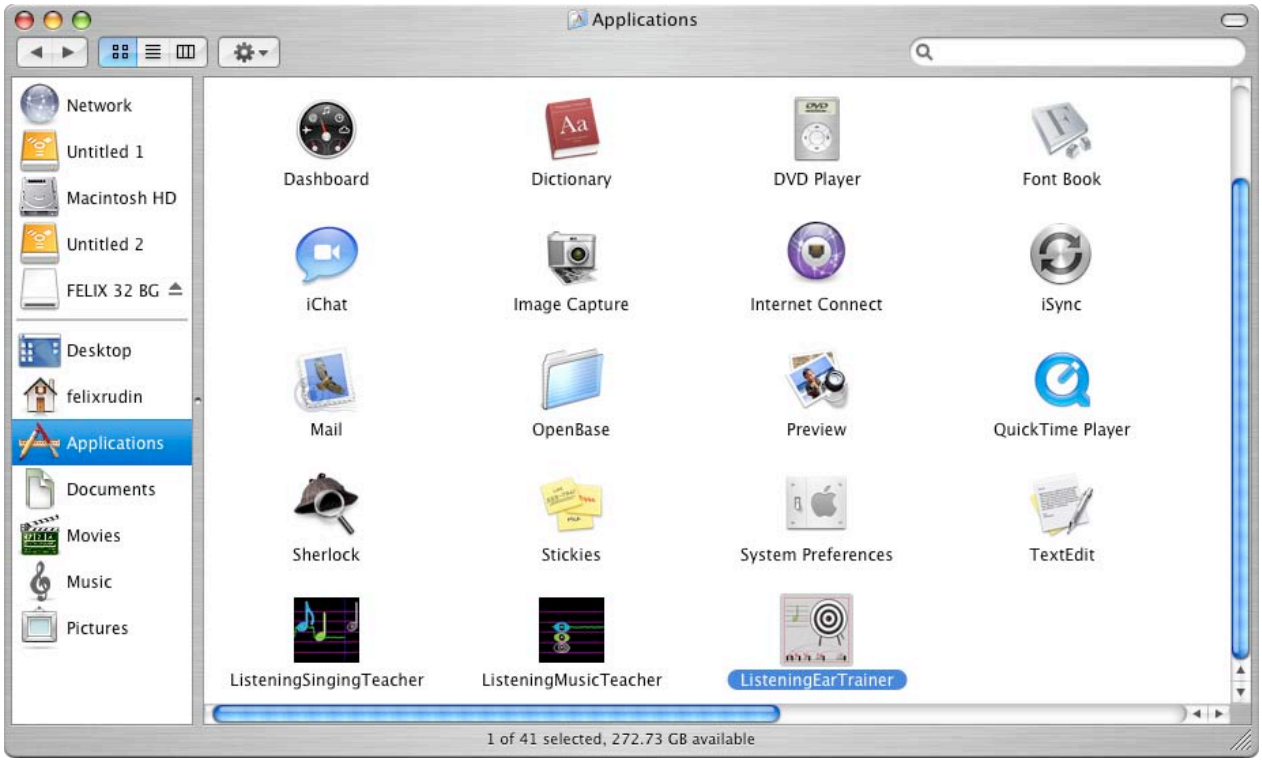


Choose if you want to install QuickTime with iTunes, or QuickTime separately. Click “Free Download Now” and follow the installation instructions.

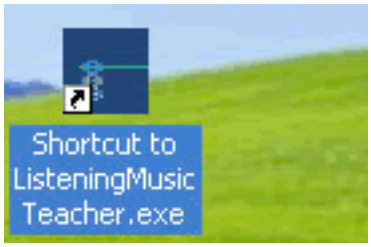
After installing QuickTime, you will be ready to use Listening Ear Trainer

First Time Use

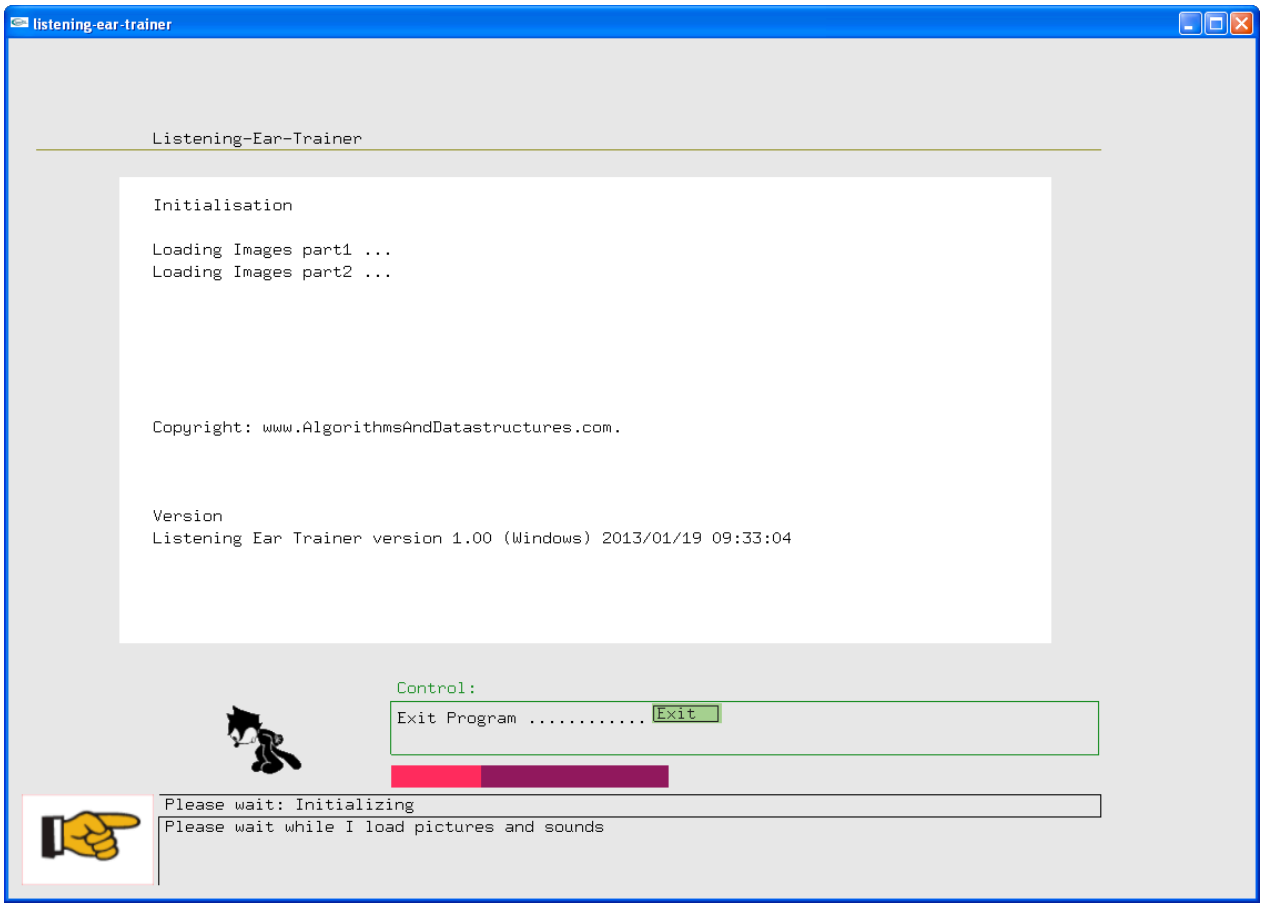
Macintosh: Double-click the application ListeningEarTrainer in the Applications folder:



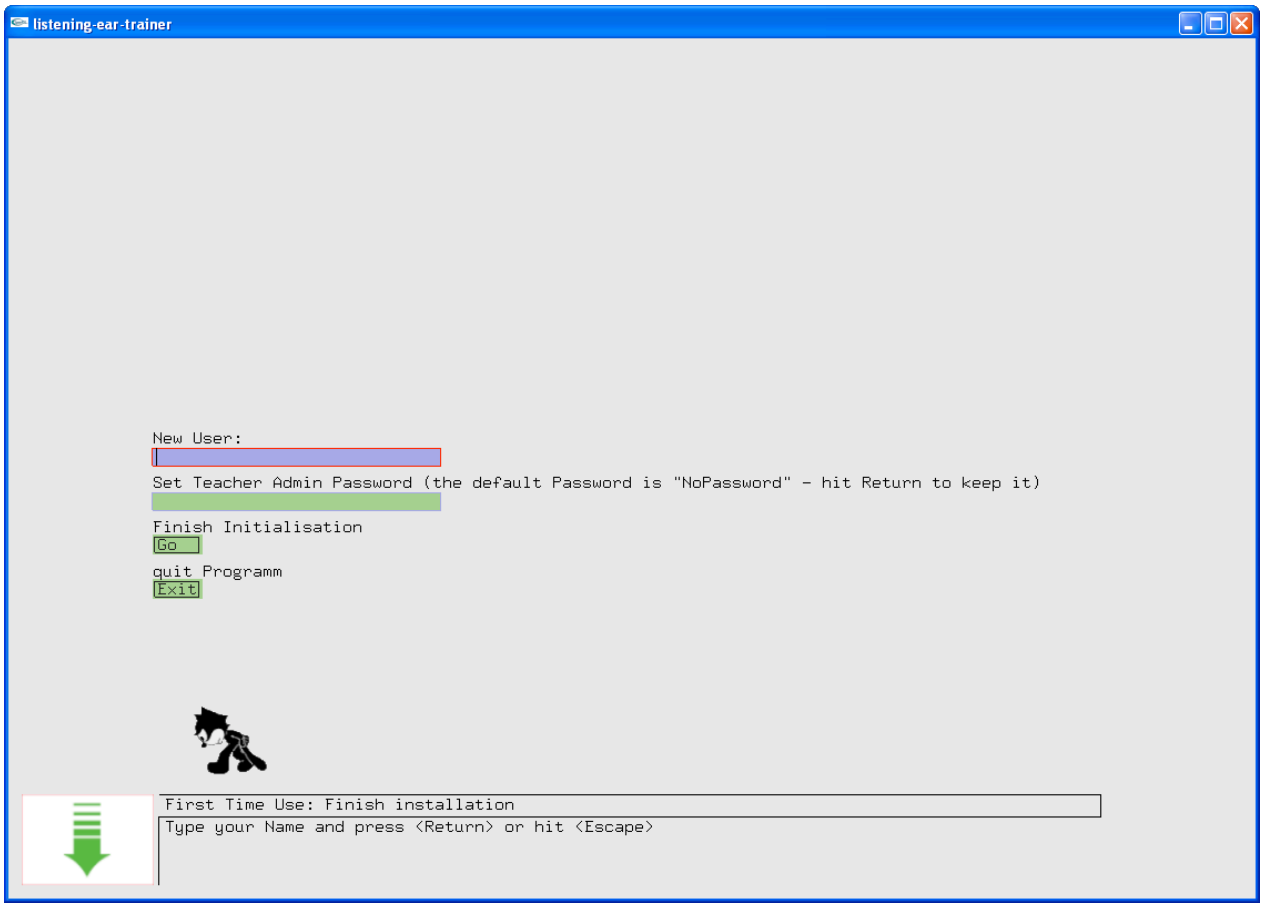
Windows: Double-click the shortcut on your Desktop:



The application starts initializing by loading images and sounds.



The first time you start the application the following dialog box appears:


listening-ear-trainer
New User:
Set Teacher Admin Password (the default Password is "NoPassword" - hit Return to keep it)
Finish Initialisation
Go
quit Programm
Exit
First Time Use: Finish installation
Type your Name and press <Return> or hit <Escape>

First you must enter a User Name. The name may consist of a First and Last Name, separated by a blank space or a comma. Only American Standard Characters are allowed.

If you want a password other than the default Admin Password “NoPassword” change it. Please be aware that the password is case sensitive. The password must have at least 5 characters. If you forget or lose your password you must reinstall the application in order to be able to delete users.

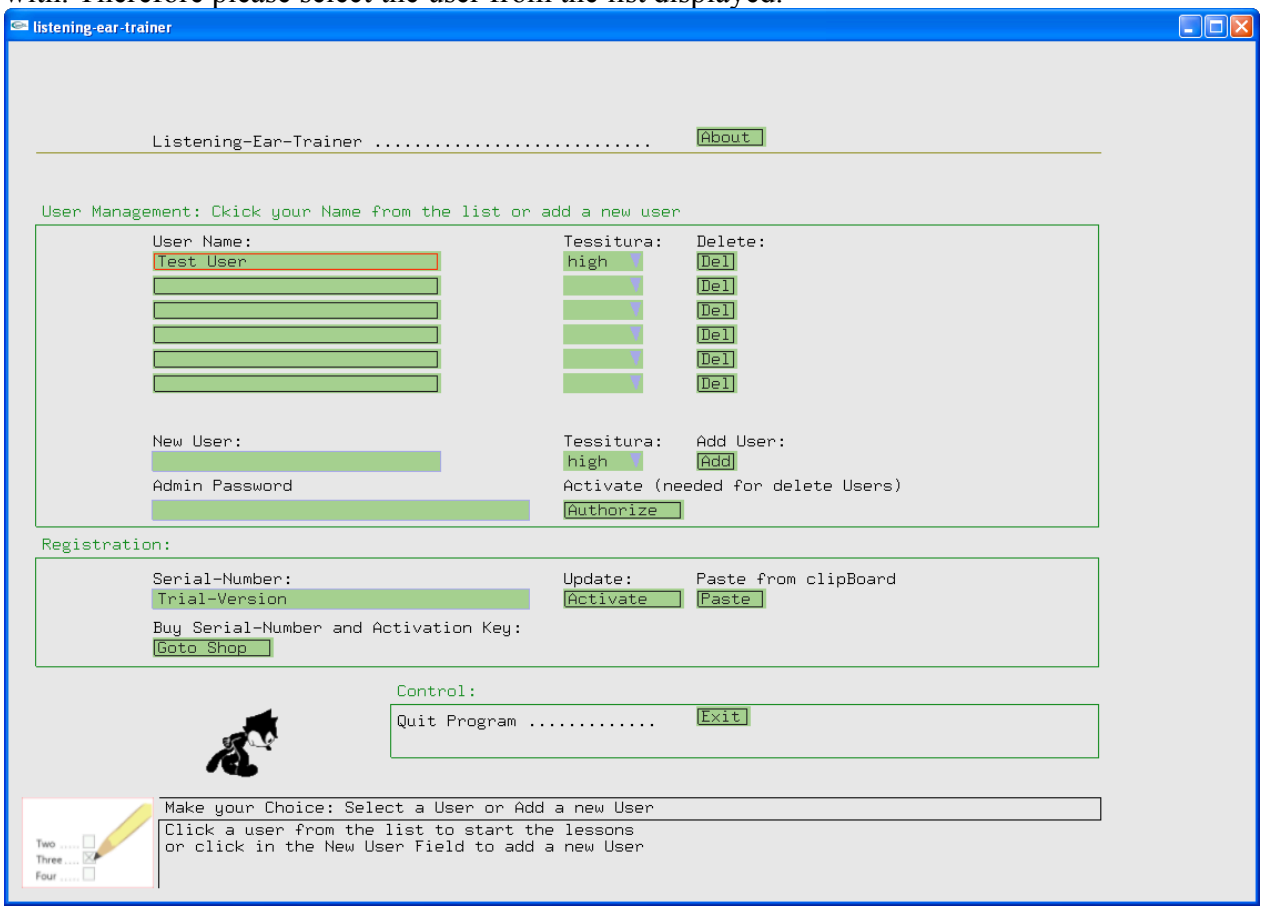
If you want to delete a user, you must enter the Admin Password and click “Authorize.” Then click the “Del” Button next to the particular user you want to delete.

When you are done click “Go” to continue.

Clicking “Exit” will leave the program in its current state so it will ask you again for the name as when first opened.

Select User

In order to collect statistics for a particular user, the program must know which user it is working with. Therefore please select the user from the list displayed.



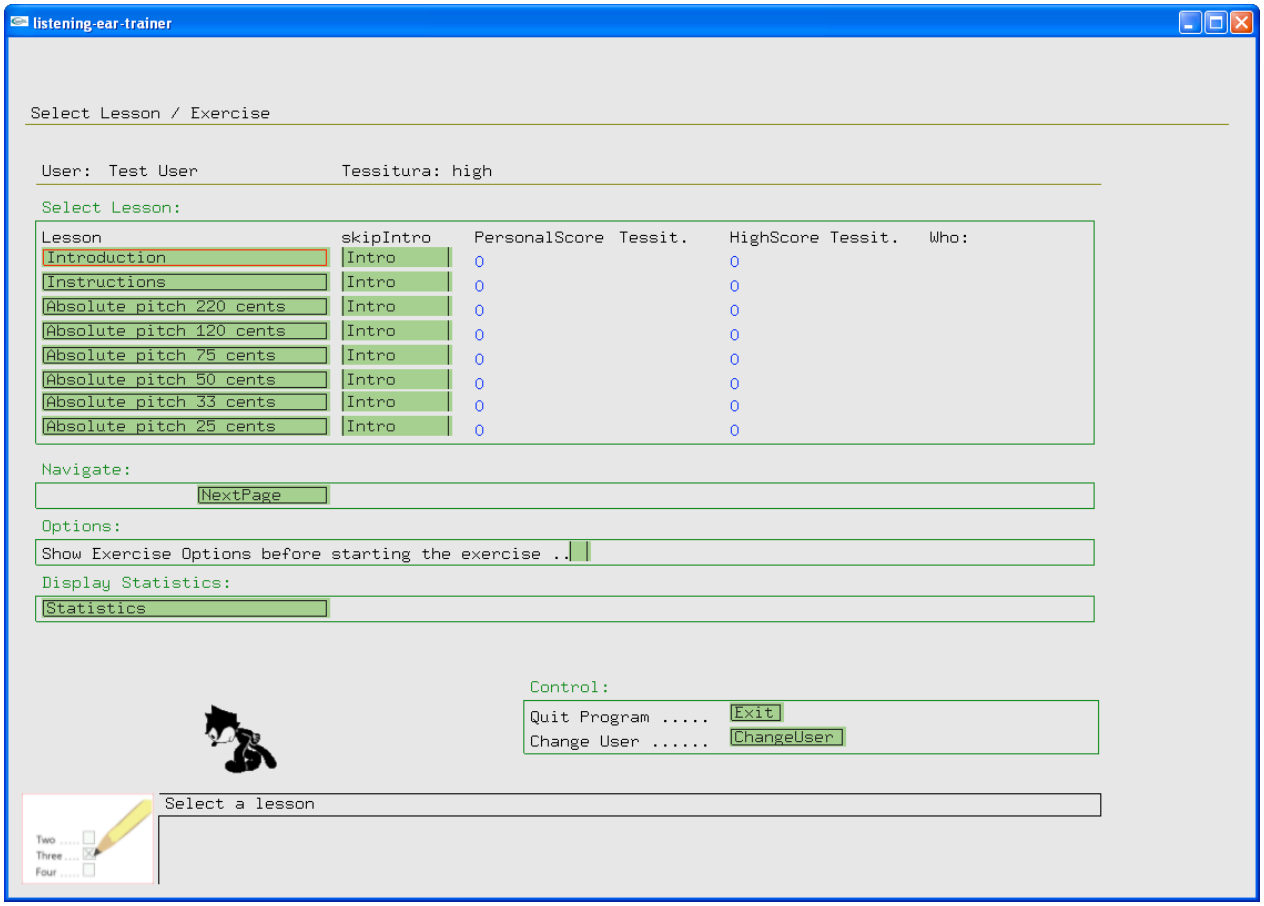
If you are not on the list you may add your name by clicking in the New User field and typing your name. Select a tessitura (see next paragraph) and click “Add.” Your name should now appear and you can select it.

To adjust the exercises to the user’s vocal range, the user must select one, called a tessitura here. “High” designates soprano, “medium” baritone, and “low” bass. You can change the tessitura anytime by going back to this dialog box. The tessitura has no effect on the pitch recognition exercises chosen; it only displays the notes in a range, which should be suitable for your voice. If your voice spans a wide range (3 octaves or more), you may go through the exercises in all tessitura modes.

The registration process is explained in the last chapter.
For now, simply select your desired tessitura and then click your name.

Select Lesson/Exercise

After selecting your name, the Select Lesson dialog box will be presented:



In the Select Lesson frame you should select the desired lesson/exercise. To the right of the lesson/exercise buttons you'll find a button that allows you to skip the explanations given for a particular lesson/exercise. Clicking a button in the column SkipIntro will change the button to read, "Skip," or if it is already on "Skip" it will be reset to "Intro."

Next to the "Skip/Intro" buttons you will see your personal high score and the tessitura in which you reached that score for this lesson. The scores are colored as follows:

- blue: You reached less than one third of the possible points
- green: You reached the basic level
- yellow: You reached more then two thirds of the possible points
- red: You have more then 90 % correct answers

As an additional encouragement, the highest score of competing players is included to the right.

In the navigation frame you'll find the "PreviousPage" and "NextPage" buttons, which allow you to page through the lessons/exercises.

Clicking on the “Statistics” button will bring you to the Statistics Section, which is explained in the Statistics chapter.

The first three lessons, entitled ”Introduction Theory,” “Introduction Chords,” and “Chord Explorer,” are introductory and explanatory only. They give no exercises to practice, nor do you earn points.

All other lessons are exercises in which you can earn points. They are presented after the introductory lessons.

Introductory Lessons: Absolute Pitch

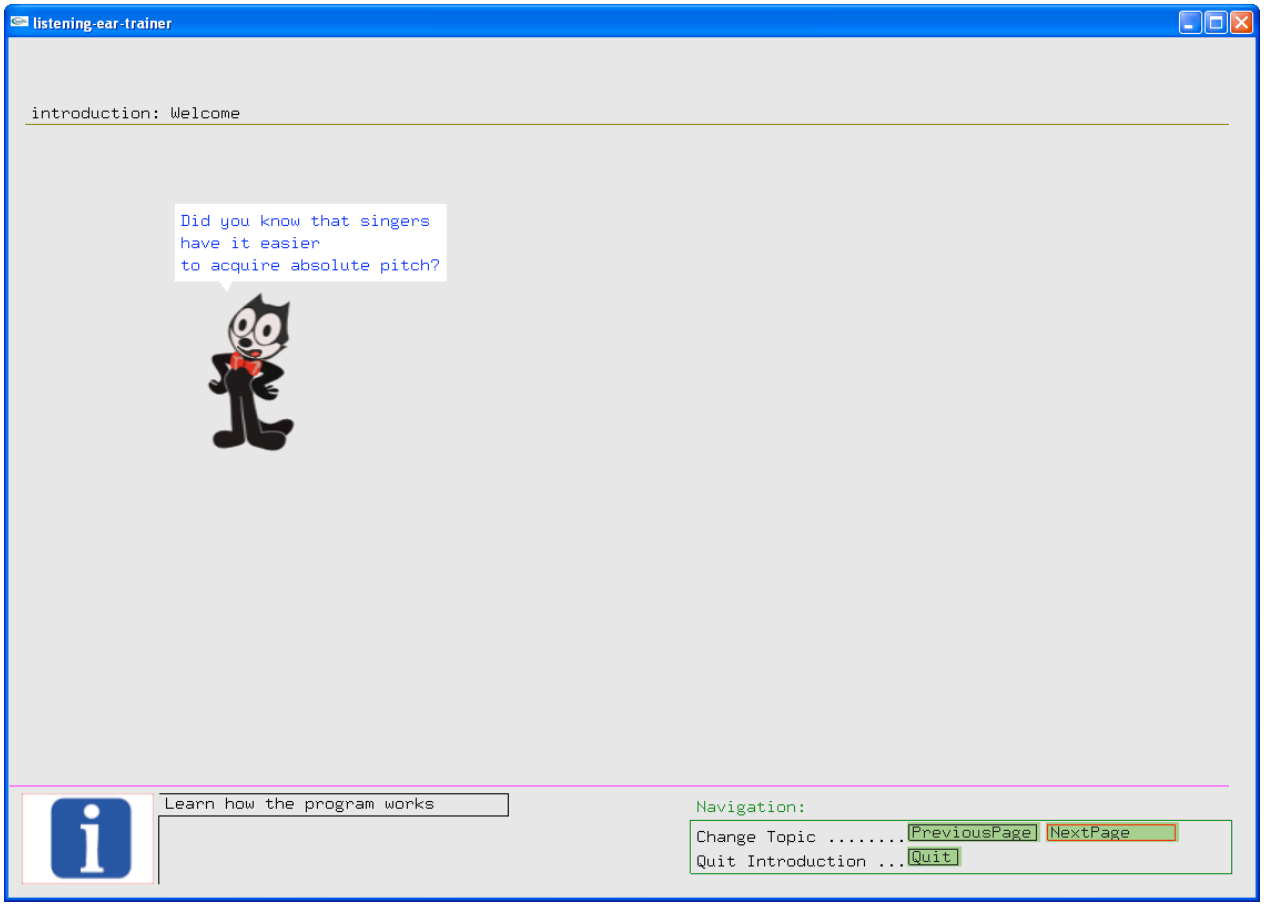
Introductory lessons are animated and explain the concept of absolute pitch and how the program works.

Introduction: Absolute Pitch

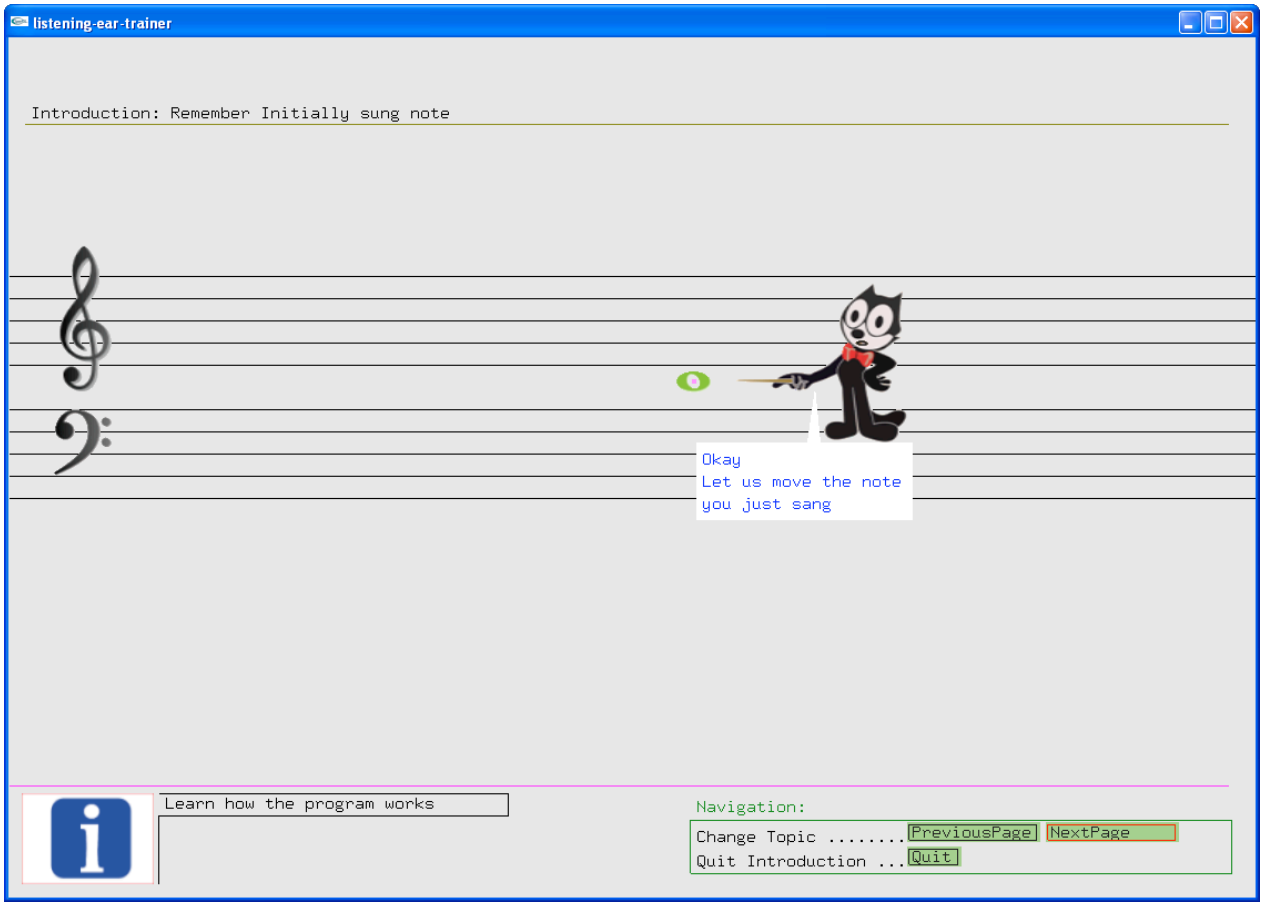
This lesson gives a short overview of absolute pitch, and demonstrates that you have the ability to hear absolute pitches.

What is absolute pitch?

When musicians are tuning their instruments, you might hear them hum during this process. Musicians tune their instruments because in some cases they must match tones within the instrument itself—i.e., the guitar strings have to play in harmony—and because the instrument must be in tune with other instruments. (Some instruments cannot match with others—for instance, a piano or an oboe often become the anchor from which all other instruments take their tuning note because the piano must be tuned by a technician, and the oboe's double reed is itself not tunable.) A trained ear is required to do this. Sometimes musicians use their voice to hold a sound for a longer time, as it's easier for beginners to hear the subtleties of tuning in their voice than from their instrument.

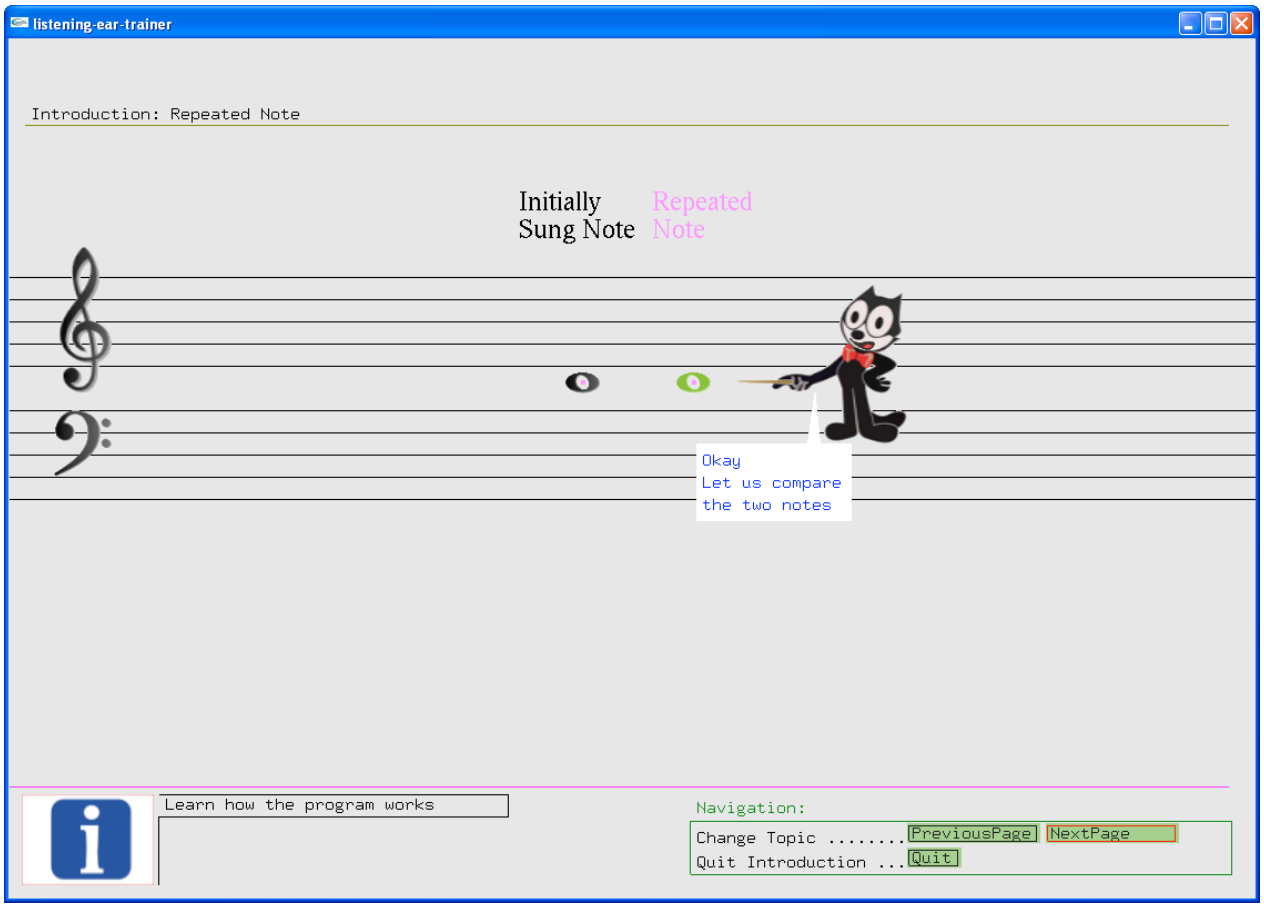

listening-ear-trainer
introduction: Welcome
Did you know that singers have it easier to acquire absolute pitch?
Learn how the program works
Navigation:
Change Topic .....PreviousPage NextPage
Quit Introduction ...Quit

To demonstrate this relationship you are asked to hum any note you feel comfortable with. The program will display your hummed pitch on the staff. The position of the note depends on the frequency you hum. Thus, the note may be placed anywhere on or in between staff lines.



In this sample a C#4 was hummed.

Next, repeat the same note.

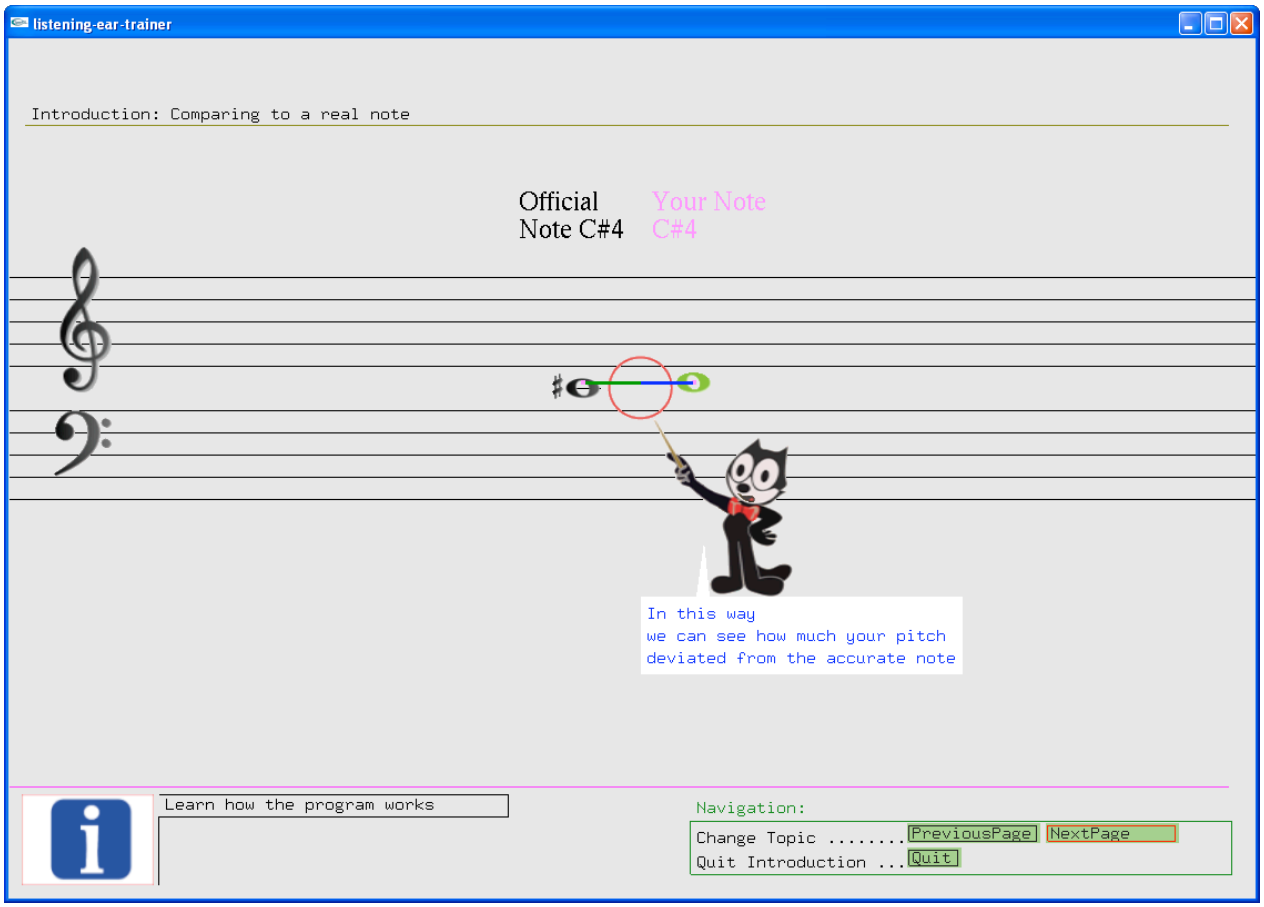


If you succeed in repeating the same pitch the program continues. This step is necessary, since consistency is required for the next step.

In the next step the program analyzes your pitch and assigns a sound to the note nearest to your hummed pitch. The program then asks you to repeat the same sound again, but from the perspective of hearing it first and imitating. Your task is now to hum the identified note.

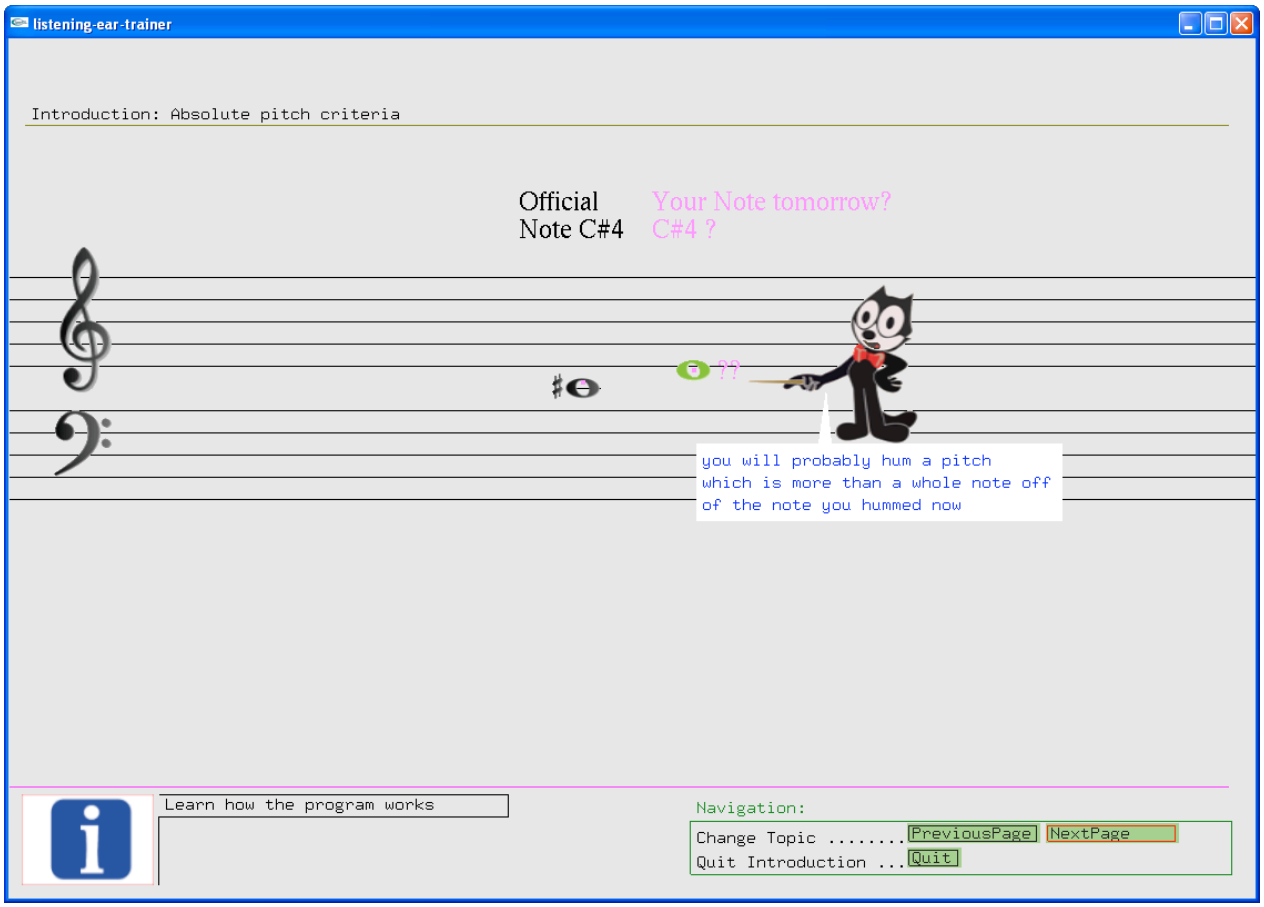
Once you have succeeded to hum the note on request, you have fulfilled the first principle of absolute pitch: Accurately singing a named pitch without an external reference.

The program continues to compare your pitch with the frequency of the given note and tells you the measurement of deviation from the pitch hummed perfectly.



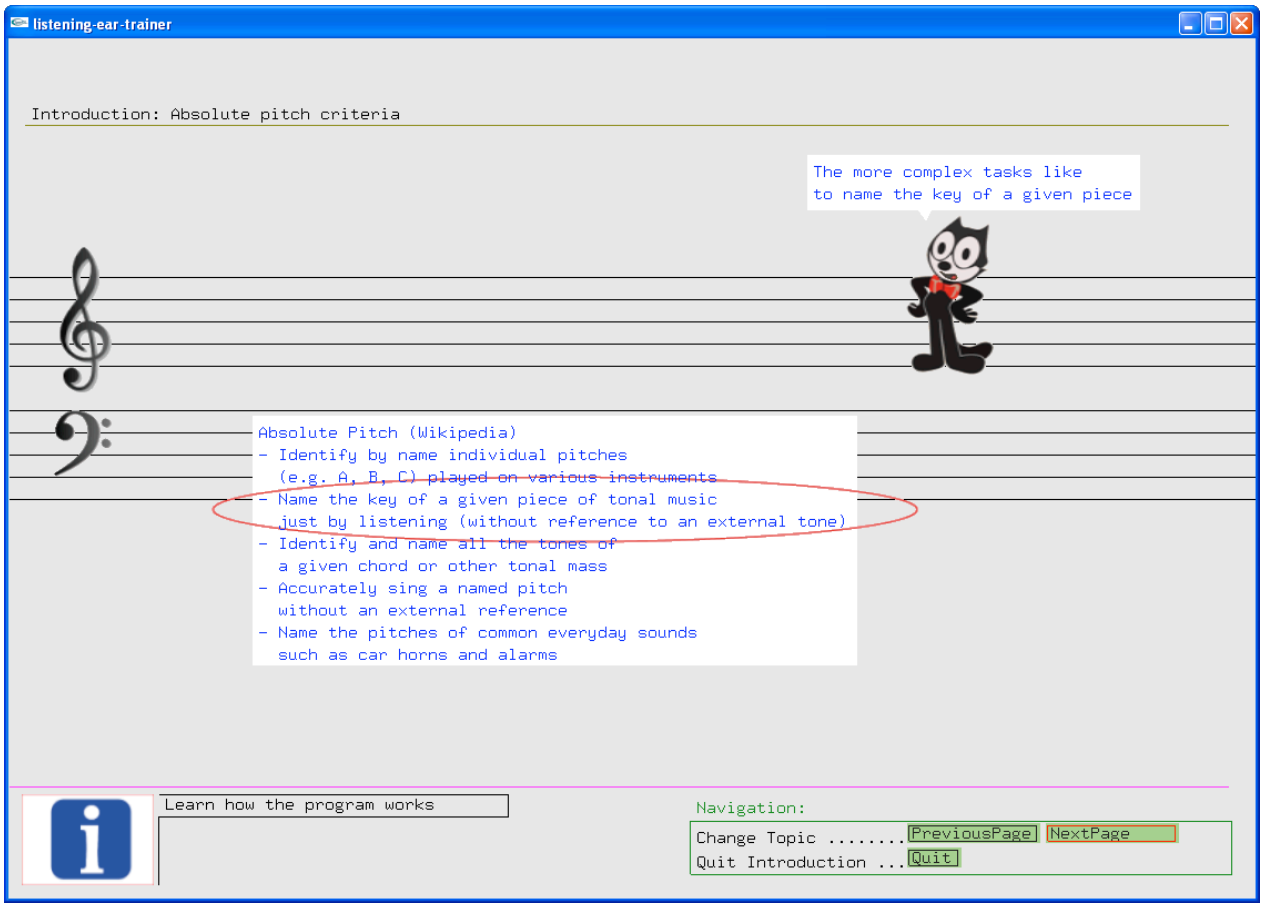
In our music system the deviation of the pitch is given in cents, whereby a deviation of 100 cents means that the sound is a semitone (or half step) off. Thus a note 100 cents away from its original frequency has the same frequency as the next higher or lower note. This distance corresponds to the minimum presentable distance between two notes: a semitone.

However the ability to accurately sing a named pitch without an external reference gets questioned immediately: if you have to hum the same sound again tomorrow, you probably will hum a different pitch and thus miss this principle. You had a reference tone when you did the exercise: the note you hummed before, but now you have to work to retain that note in your memory.



As you do the exercises your control of your vocal muscles will increase. And with fine-tuning your listening skills will sharpen and your ability to remember the pitch of a note through your inner ear will increase. If you should hum the same note the next day, you will likely be more than a whole note off. Because your brain is not trained to recollect pitches to this degree of accuracy, or your vocal cords are looser or tighter depending how much you have used them that day. Nevertheless, the pitch might be near the pitch you hummed yesterday.

Detecting the pitch of a note is not the only principle for absolute pitch.


listening-ear-trainer
Introduction: Absolute pitch criteria
The more complex tasks like
to name the key of a given piece
Absolute Pitch (Wikipedia)
- Identify by name individual pitches
(e.g. A, B, C) played on various instruments
- Name the key of a given piece of tonal music
just by listening (without reference to an external tone)
- Identify and name all the tones of
a given chord or other tonal mass
- Accurately sing a named pitch
without an external reference
- Name the pitches of common everyday sounds
such as car horns and alarms
Learn how the program works
Navigation:
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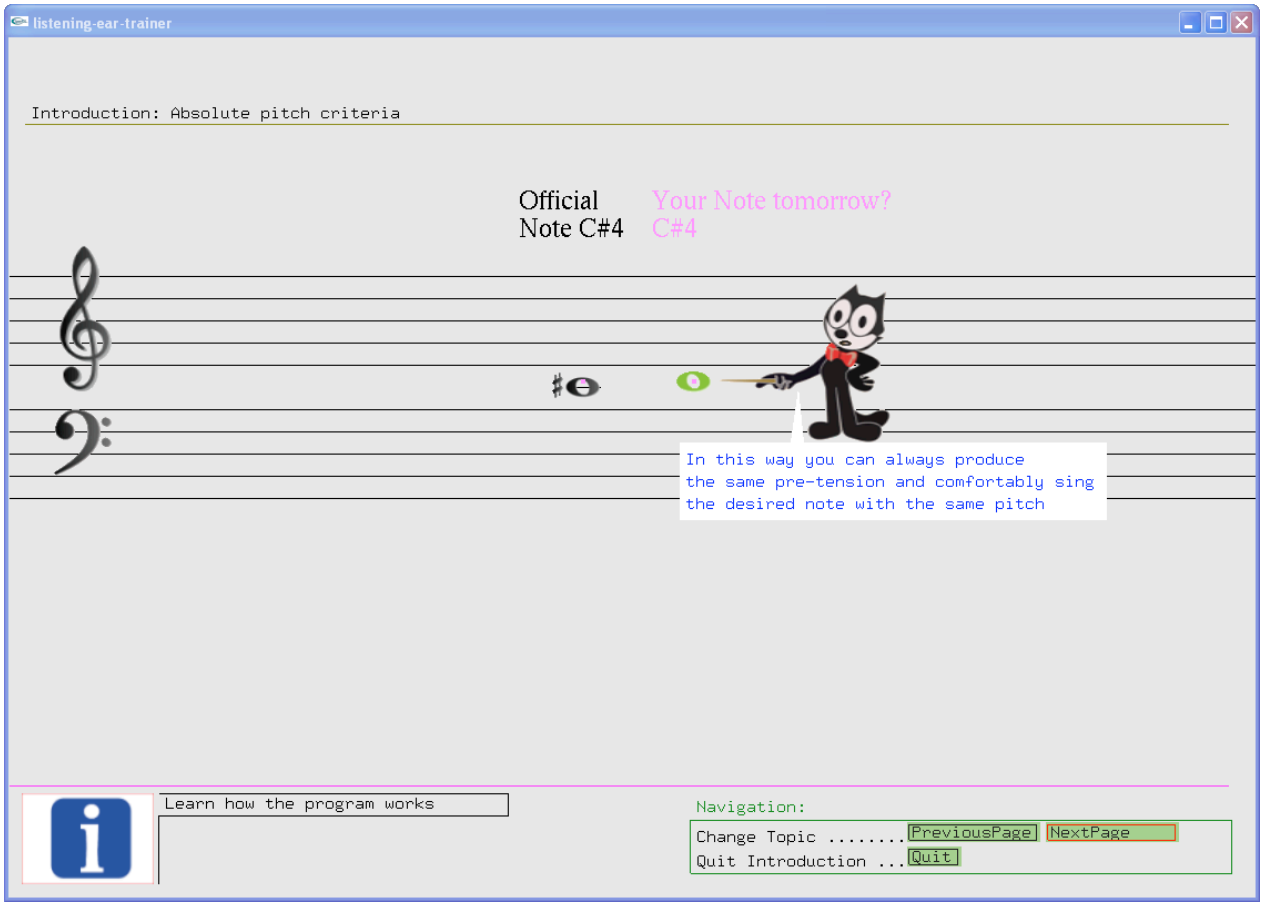
More complex tasks like naming an interval or chord can be done by amplifying the individual pitches in your head. Applying the rules of music theory will then give you the answers to the question. If you have a lot of musical training you will not have to go through this serialization process for long, as your brain will start taking a shortcut. Thus you will be able to respond correctly more immediately. The same thing happens when you learned to multiply: A very roundabout way of thinking through multiplication is, for instance, nine times something equals something times ten minus something. You would only use this procedure as a fallback if the something were larger than ten. Otherwise, you would have gained the answer spontaneously through memorization. Thus when you do exercises for recognizing intervals, you will get faster and faster through memorization of the tones. Finally, for some intervals you will have the answer spontaneously, and if you continue with the exercises you will master all intervals that way. The same might happen for recognizing triads; and finally you will recognize a chord progression as a natural rule. However, this is a long process, it will not happen over night. Those who acquired absolute pitch during childhood also took a year or two to associate musical names or terms to those sounds, and these will come with practice.

To acquire absolute pitch with the singing funnel method you have to focus first on reproducing a particular sound. That is, you have to remember, imagine, and aim ahead to the sound you want to produce before you start singing. This is you inner ear. It has more to do with positioning your vocal cords than with listening. Remember: when you say “Ah” or “Oh” you give your vocal cords precise commands so that the desired sound comes out. You can do this for pitches, too. We provide the perfect method to build your pitch memory.

To produce the same sound over and over again, you have to relax and then tense your vocal cords to a remembered level.

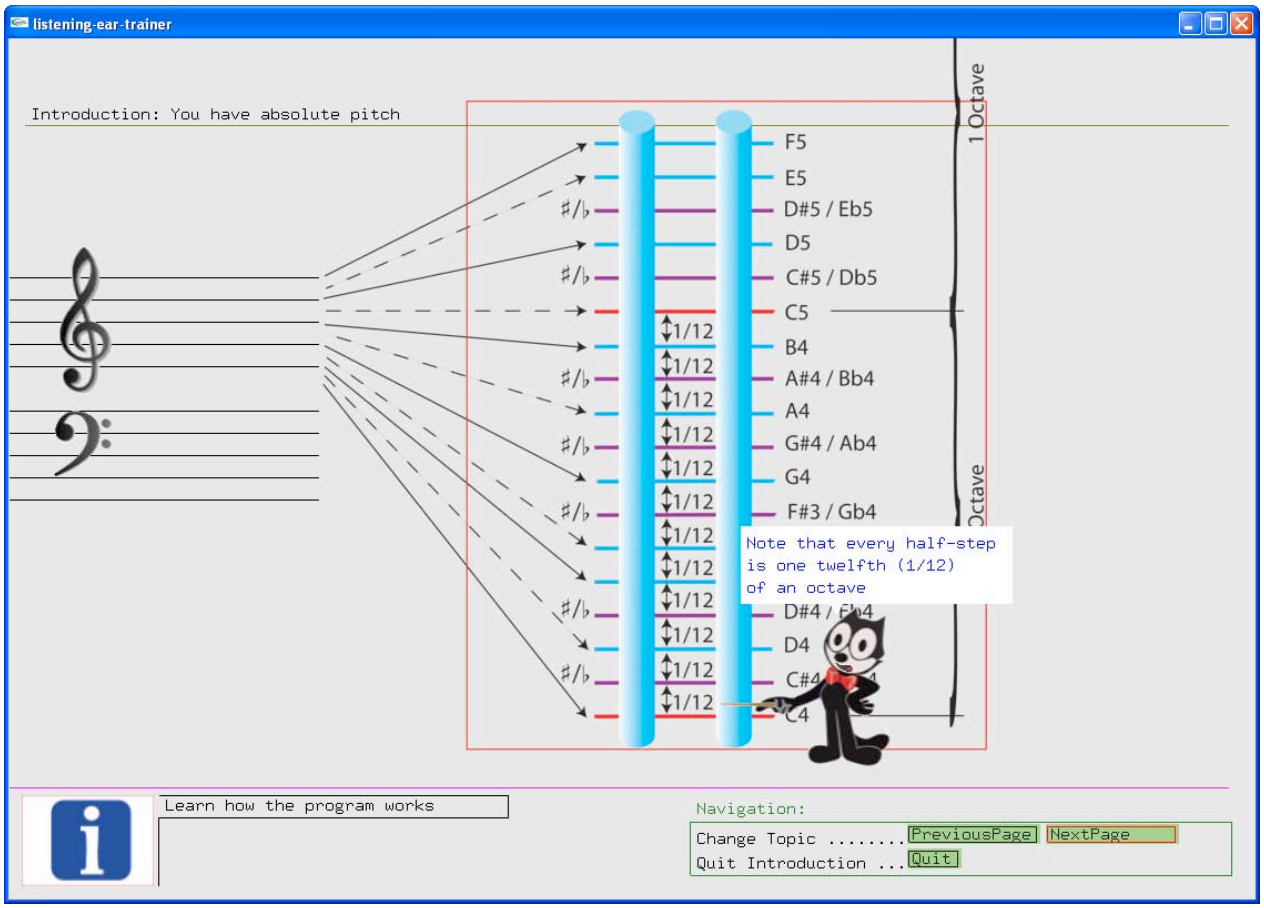


Since automatically singing a pitch accurately involves listening skills, you can improve your recognition abilities through singing by transforming your near misses to hits. The exercises will guide you from near misses, where you are allowed a small range of responses—more than a whole note off—to a precision of 7 cents. For more details about this method see the next chapter: Instructions.

Attention: Listening Ear Trainer does not teach you music theory. Listening Ear Trainer uses the voice as an instrument to do intuitive ear training. With the voice you can only produce one pitch at the time, the way you did when you sang as a child. When you learn to speak, you go through a stage called “one word” sentences. Similarly, for music the child learns to recognize single notes first. We believe you must embrace this stage in order to succeed, so we begin there. In our opinion it’s the only way to develop the important ability to sing in your head. The basic skill is to feel music sensorily, in the vocal cords. Music theory comprises a second step that helps you classify a group of pitches into musical terms and concepts. For more information about music theory, we refer you to our products: Listening Music Teacher (triads and seventh chords) and Listening Singing Teacher (basic music notation, rhythm concepts, singing in tune, and building tonal memory).

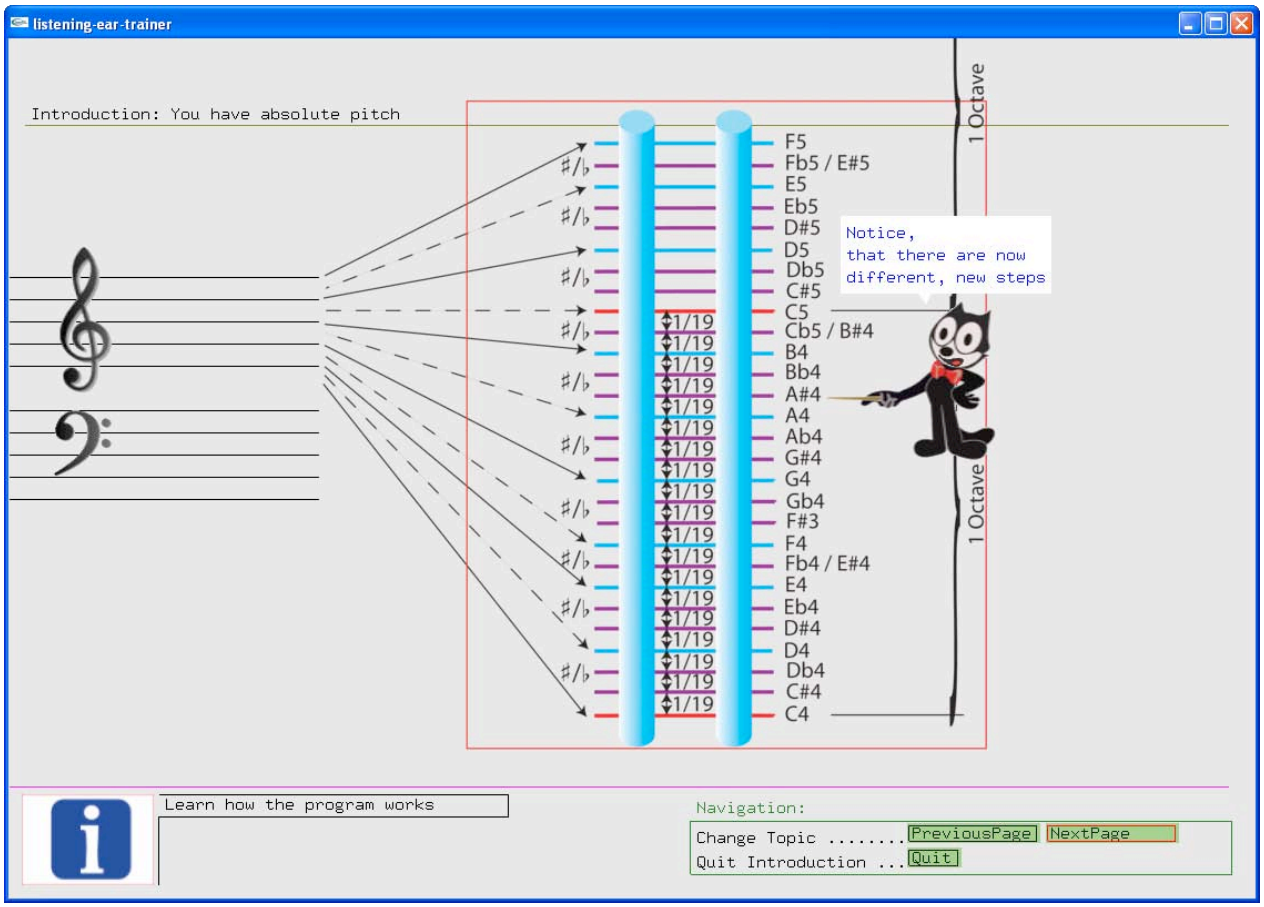
Everybody has perfect pitch

Everybody has perfect pitch. The question is just how good your ability to differentiate pitches is. To explain this, we will take a closer look on music systems. First we look at the standard Western music system.



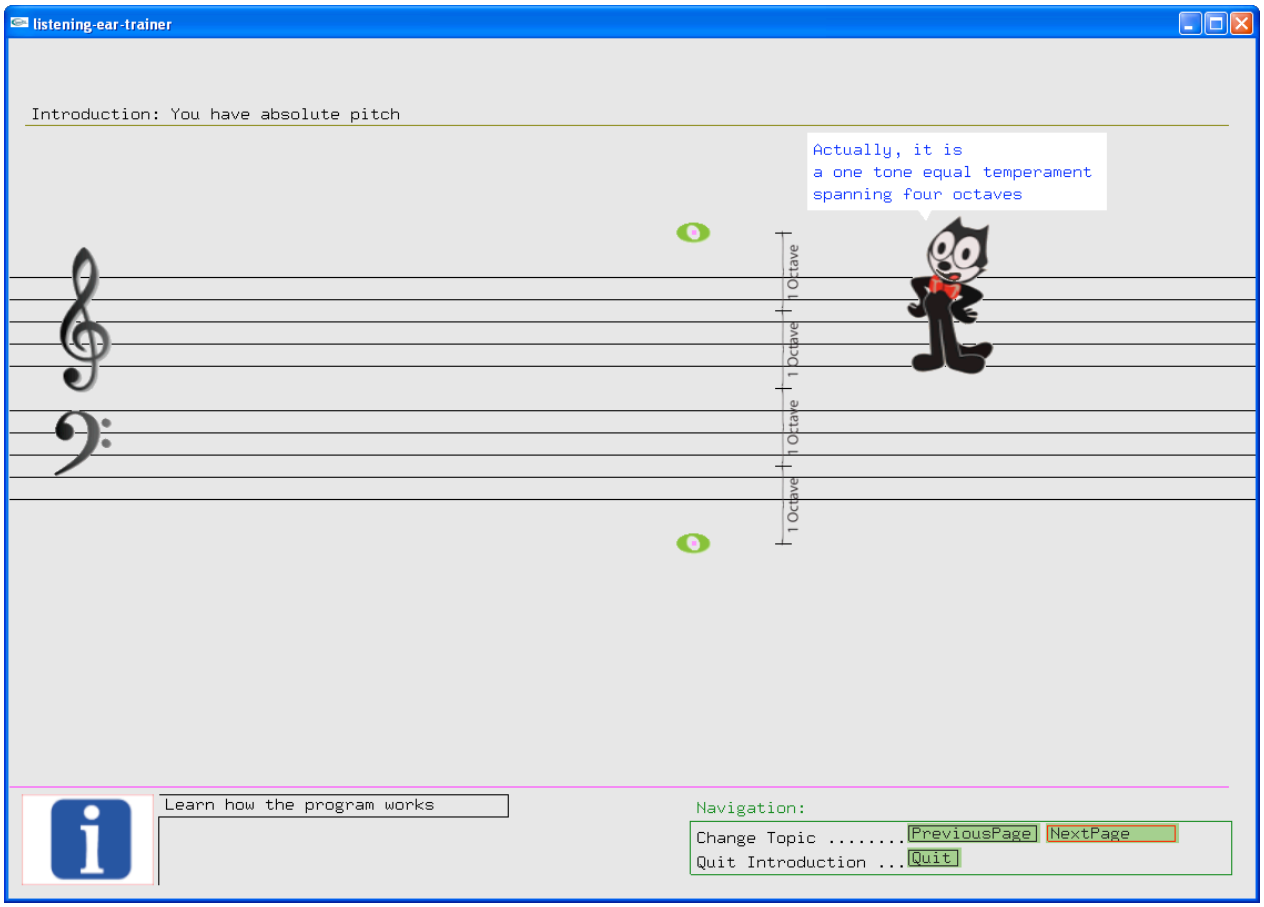
For those interested in the physics of acoustics, which forms the basis of this method, as explained in the introduction, we note an important detail here: The frequencies increase by a factor of the twelfth root of two from step to step. In this way the steps form the equal 12-tone temperament, which includes the 12 semitones of the octave.

But music is so diverse that there is room for other systems. Since the equal-tempered 12-tone system deviates from the natural, just intonation, many other systems are in use, which try to minimize this deviation.



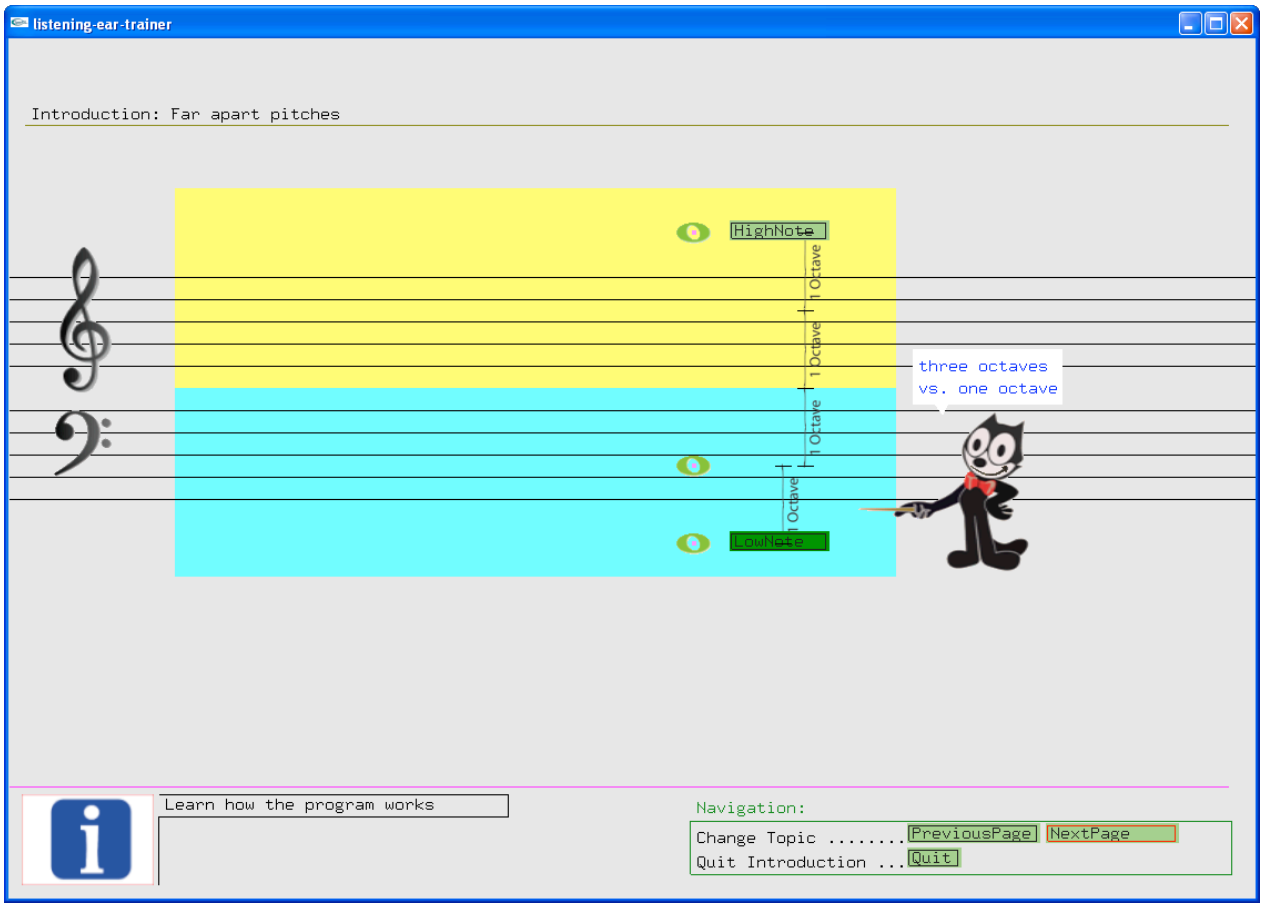
For example the 19-tone equal-tempered system gives more freedom to describe the pitches, since they include 7 more notes in the octave.

To demonstrate that you have perfect pitch, we do the contrary: we reduce the number of notes and increase the range to four octaves. In this way we get a simple two-note system: the system consists of only a low note and a high note.



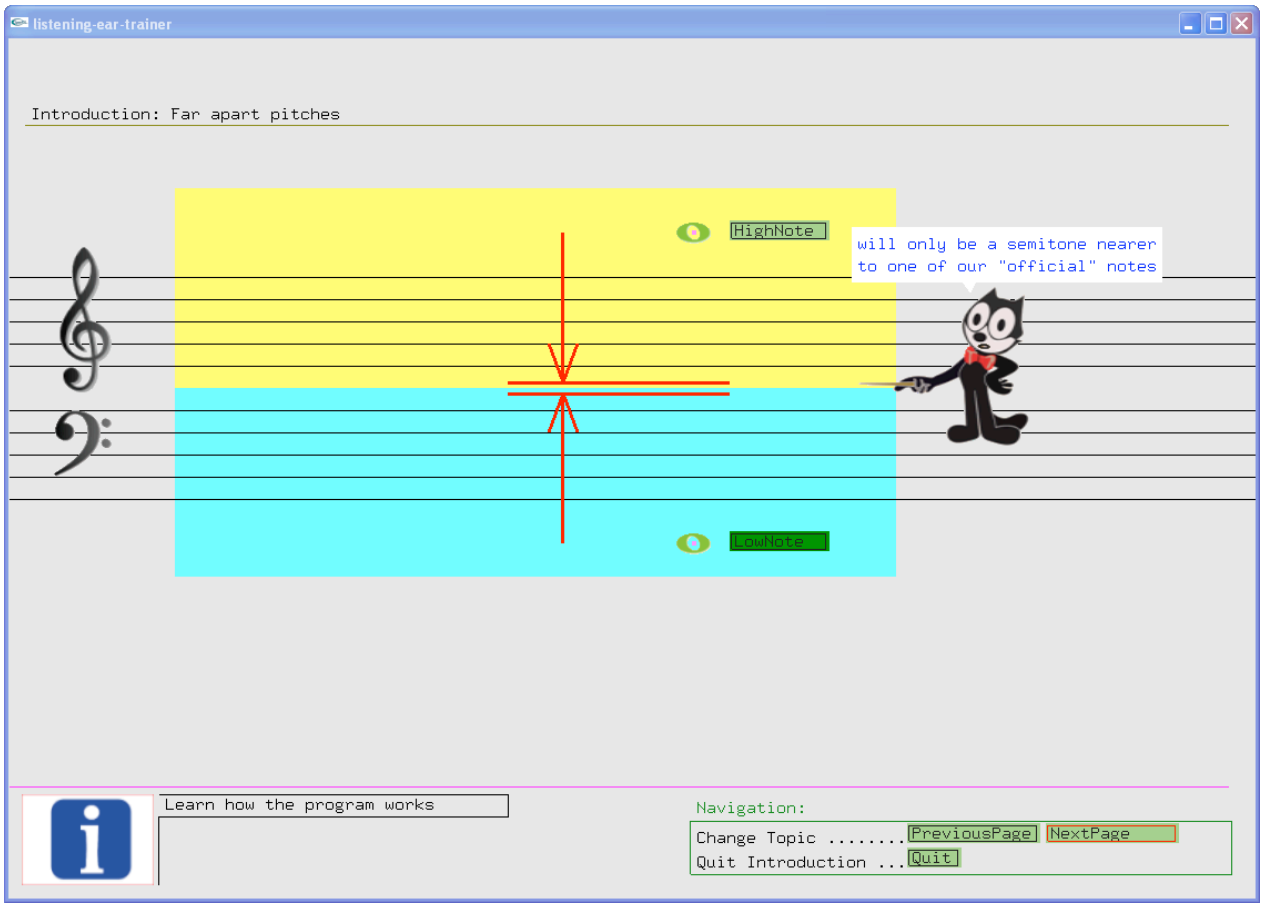
The following test, where you have to identify the note you hear, you will pass with ease. The system is so simple that you cannot fail the test. If you cannot distinguish a low C2 (the low note in our two note system) from a high C6 (the high note in our system), then we must assume that a physical handicap exists.

However, in real life the pitches of the notes are not always played correctly. The pitches may vary a few cents and will still be identified correctly. In our system with only two notes, the pitches may be off a whole octave and can still be assigned the correct note: either to the low note or to the high note. Therefore we continue by playing a note that is off by an octave to our available two notes. . Your task is to click the button you believe you should assign the sounded off note pitch to: “LowNote” or “HighNote”.

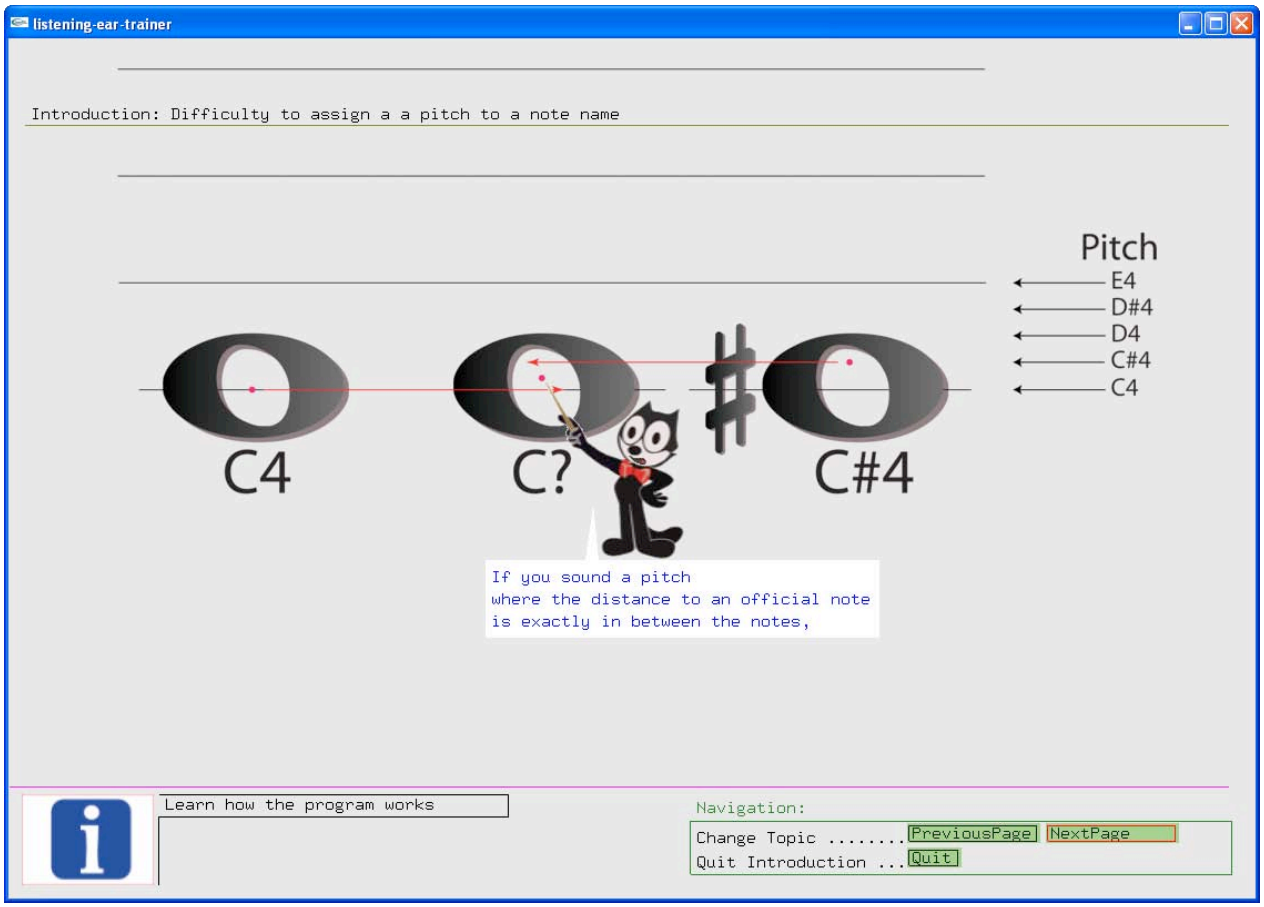


This question is still pretty easy to answer, since the pitch differences are quite large.

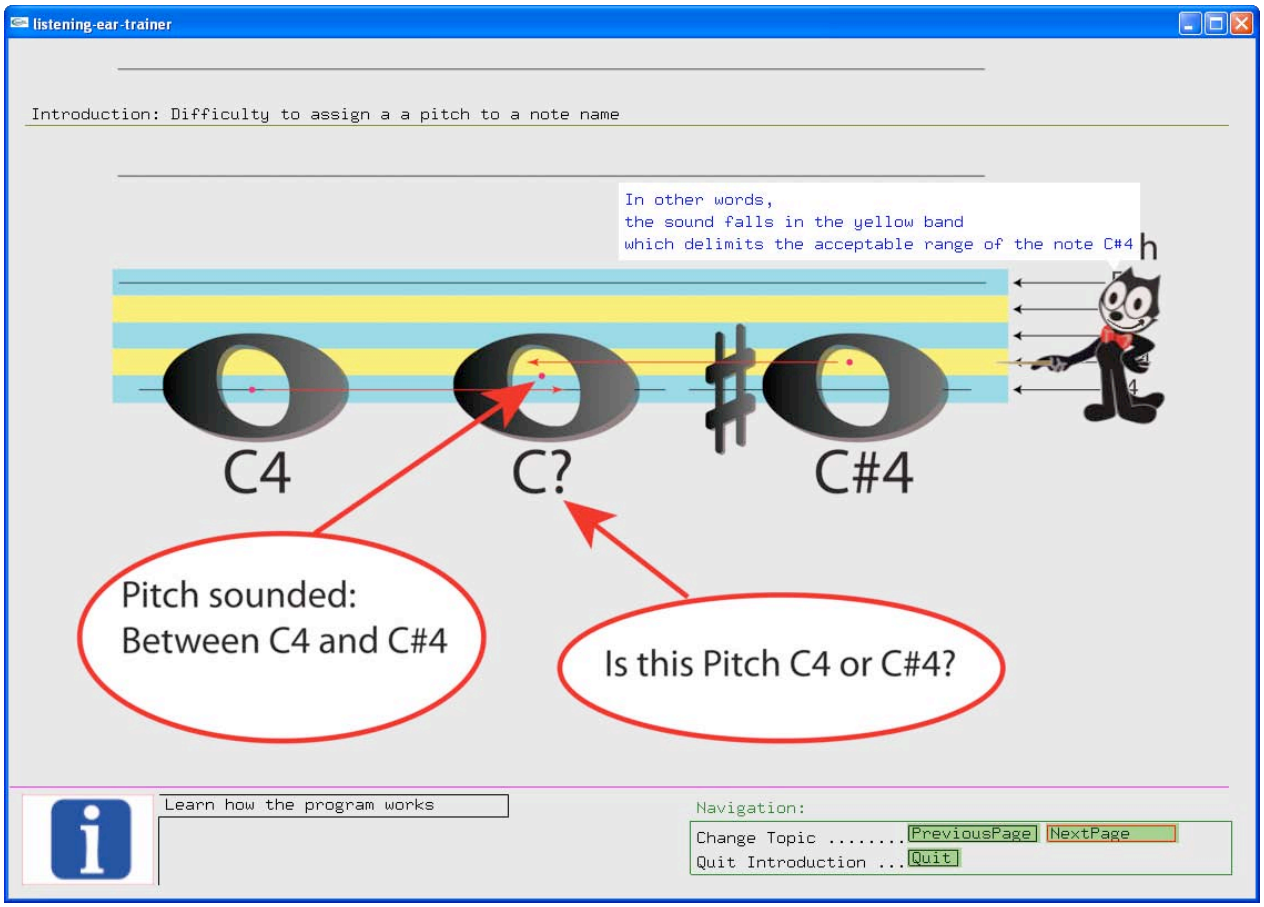
In the next test it gets very difficult to this assignment. Since the sounded pitch is nearly in the middle of our two notes. That is the pitch sounded is only a semitone away from the middle. If you have a good ear then you can still assign the sound to either the low or high note. Don't worry if you fail this test, you are here to learn to understand the concept of our method.



This test shows us where the difficulties lie: How well can we differentiate two notes? Even people with absolute pitch cannot differentiate a sound exactly in the middle of two adjacent notes, or deviates only by a very small percentage towards a note in the semitone scale.

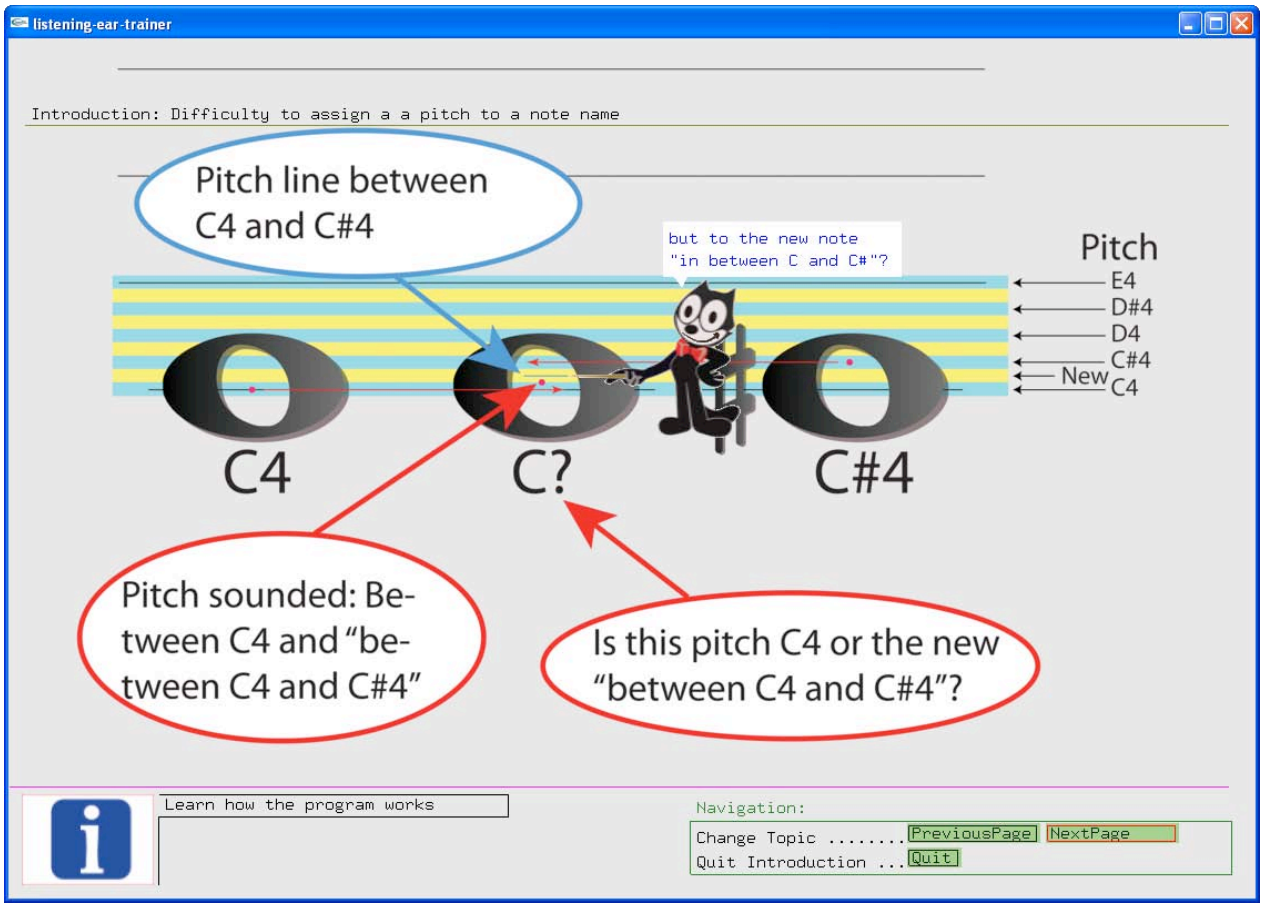


Our ears are not accustomed to hearing very small differences in pitch. Theoretically a sound a little higher pitched than the middle pitch would be assigned to the upper of the two surrounding notes.

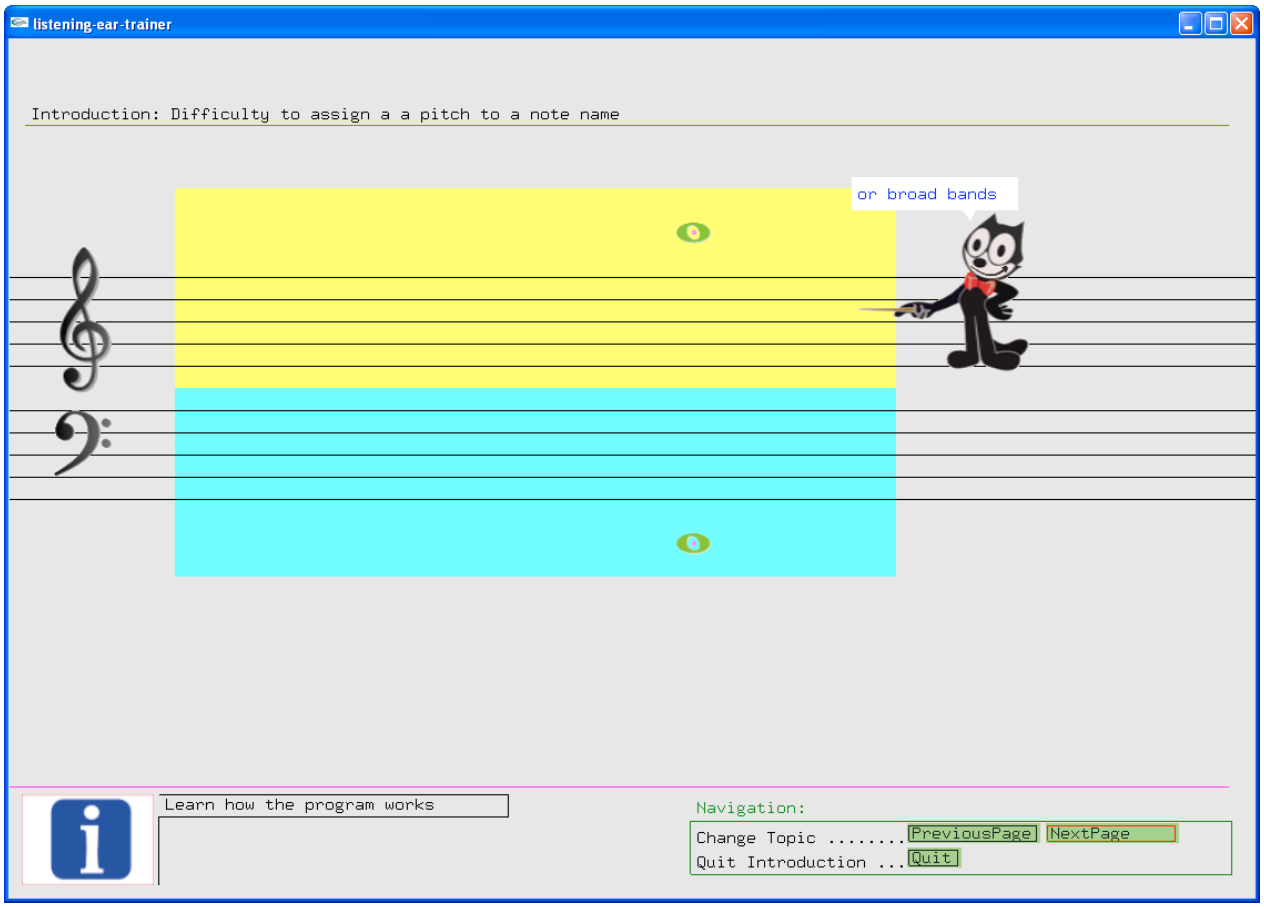


If you have a good ear, and you are not sure if the pitch belongs to the higher or lower note, you would answer that the pitch is in between the two notes.

So we might introduce “in between” notes, which would allow identifying a pitch more precisely, since we would now have more sounds (or notes) to choose from. But this would only shift the problem to: When do you assign a note to an “in between” note instead of a note on the scale?



So, the task to assign a pitch to a note is the same whether you have small bands (as in the above picture with "in between notes") or broad bands (as in the two note system).


listening-ear-trainer
Introduction: Difficulty to assign a a pitch to a note name
or broad bands
Learn how the program works
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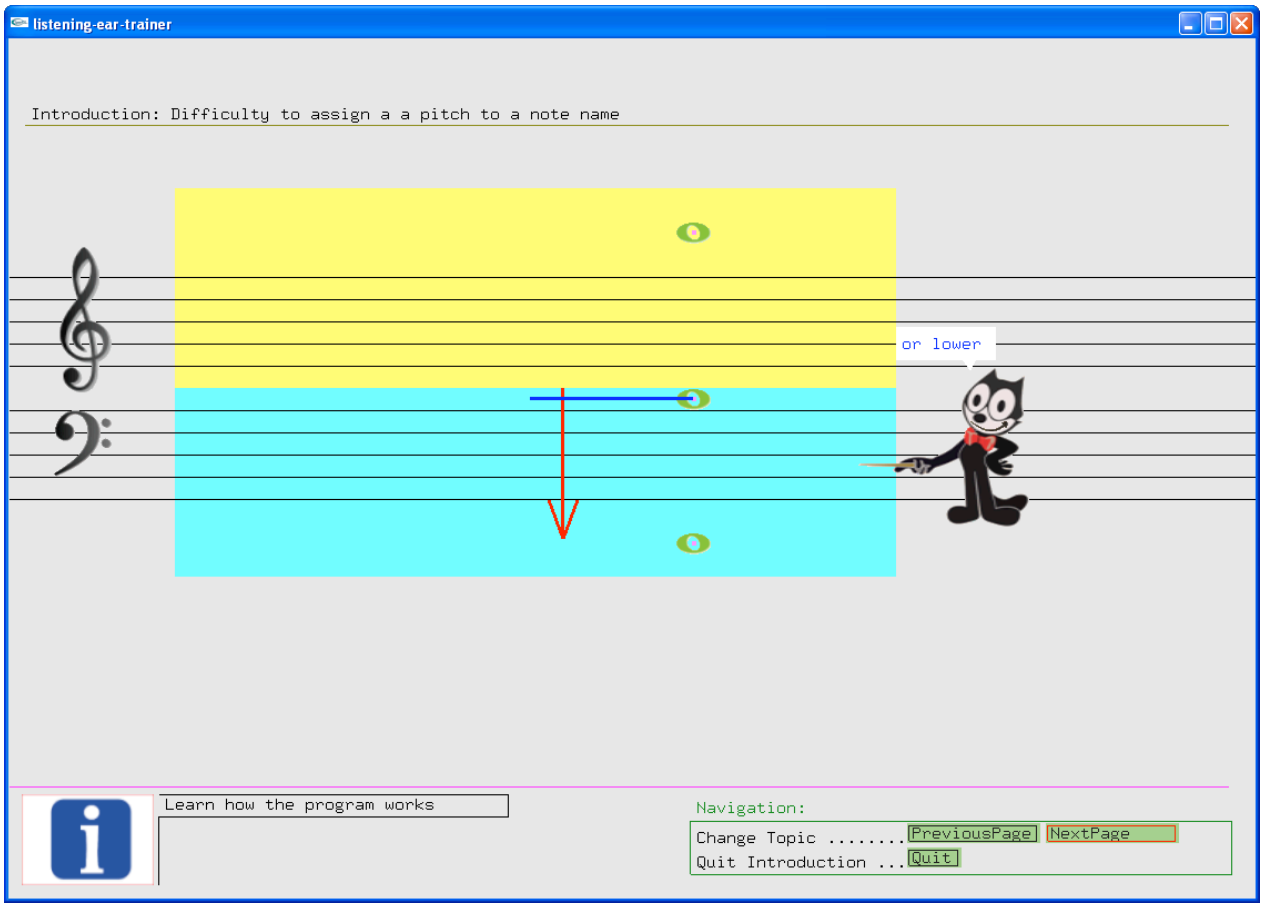
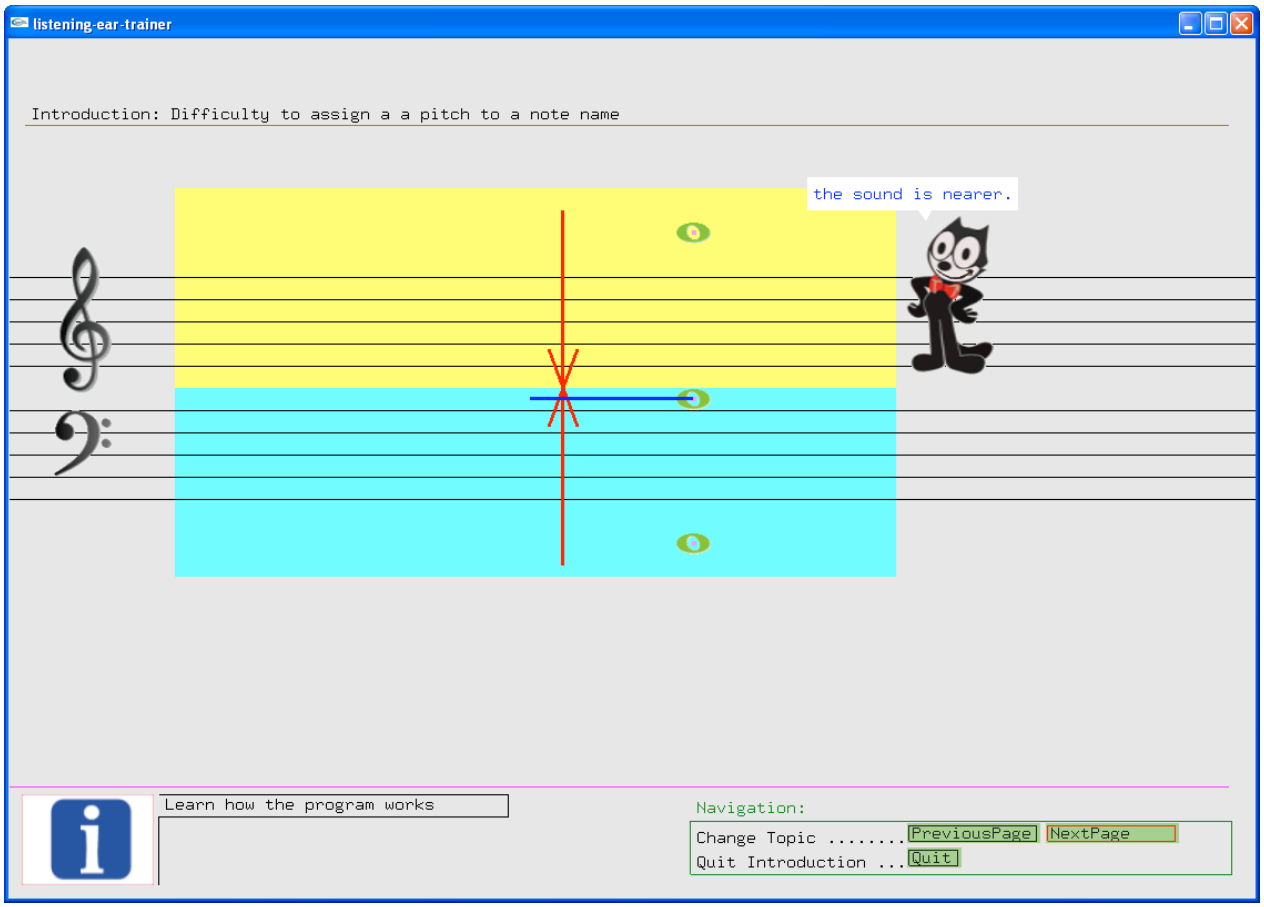
You have to decide whether a sound is higher or lower than the middle frequency between bands.



Or you have to decide which of the two notes the sound is nearer.


listening-ear-trainer
Introduction: Difficulty to assign a a pitch to a note name
the sound is nearer.
Learn how the program works
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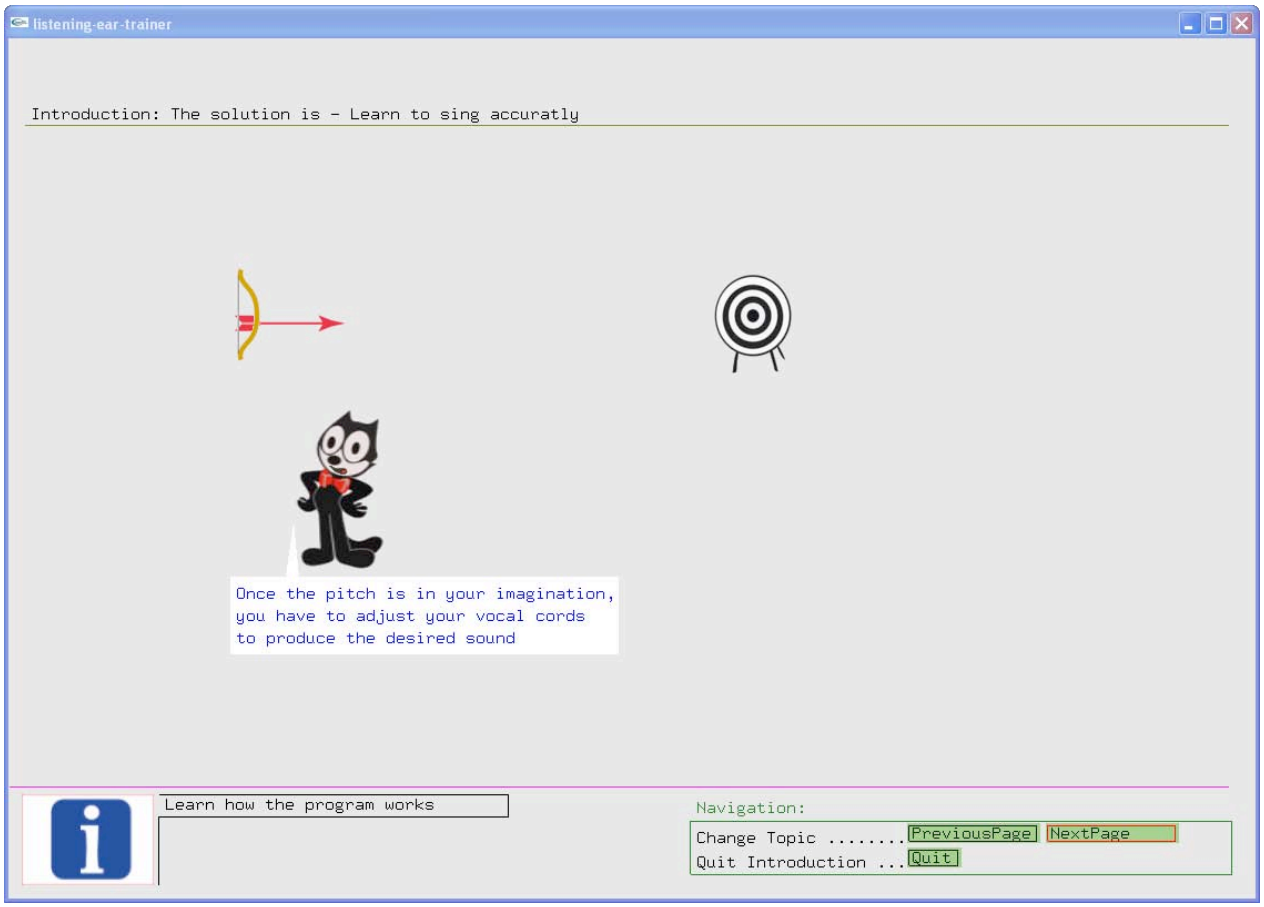
Since fixed tuned instruments (like the piano) produce notes for the 12-tone equal temperament, we hear these notes much more often than the sounds making up the flipping pitches. By flipping pitch we mean a sound that is in the middle of two adjacent notes. Therefore it would be very difficult to use the higher or lower than the middle note approach.

To improve your ability to differentiate between closely adjacent pitches, you would need to train with an instrument that can produce such sounds between two notes. The best way is: Learn to sing accurately. Since your voice will probably produce pitches, which are in between the 12-tone scale, this will give you the chance to listen for the deviation and to correct the pitch. With the singing method you will always conceptualize a note with your inner ear before singing it.


listening-ear-trainer
Introduction: The solution is - Learn to sing accuratly
Once the pitch is in your imagination,
you have to adjust your vocal cords
to produce the desired sound
Learn how the program works
Navigation:
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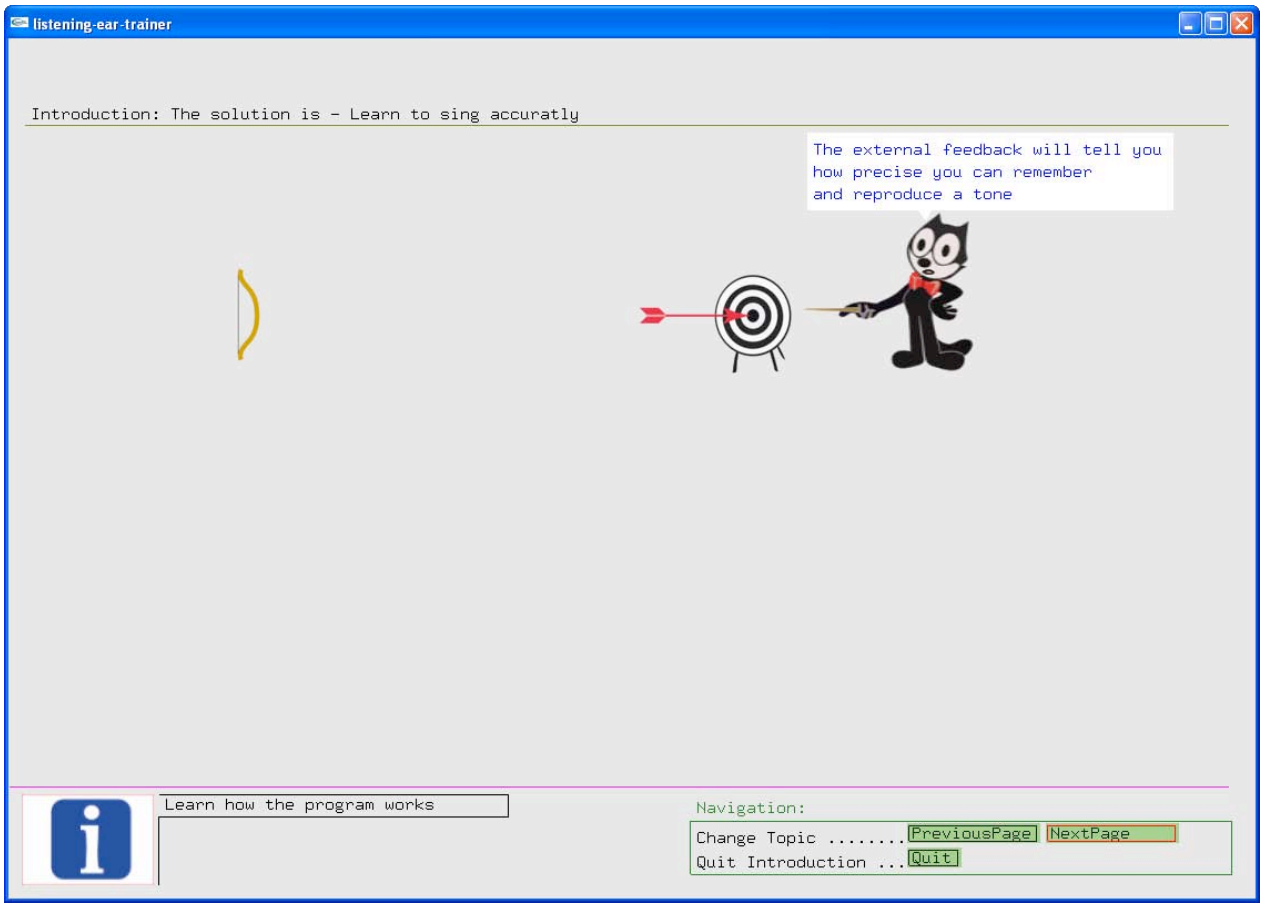
When you express the conceptualized pitch by singing, the external feedback will tell you how precise you have remembered and reproduced the tone.


listening-ear-trainer
Introduction: The solution is - Learn to sing accuratly
The external feedback will tell you
how precise you can remember
and reproduce a tone
Learn how the program works
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To achieve absolute pitch, you have to remember pitches accurately.

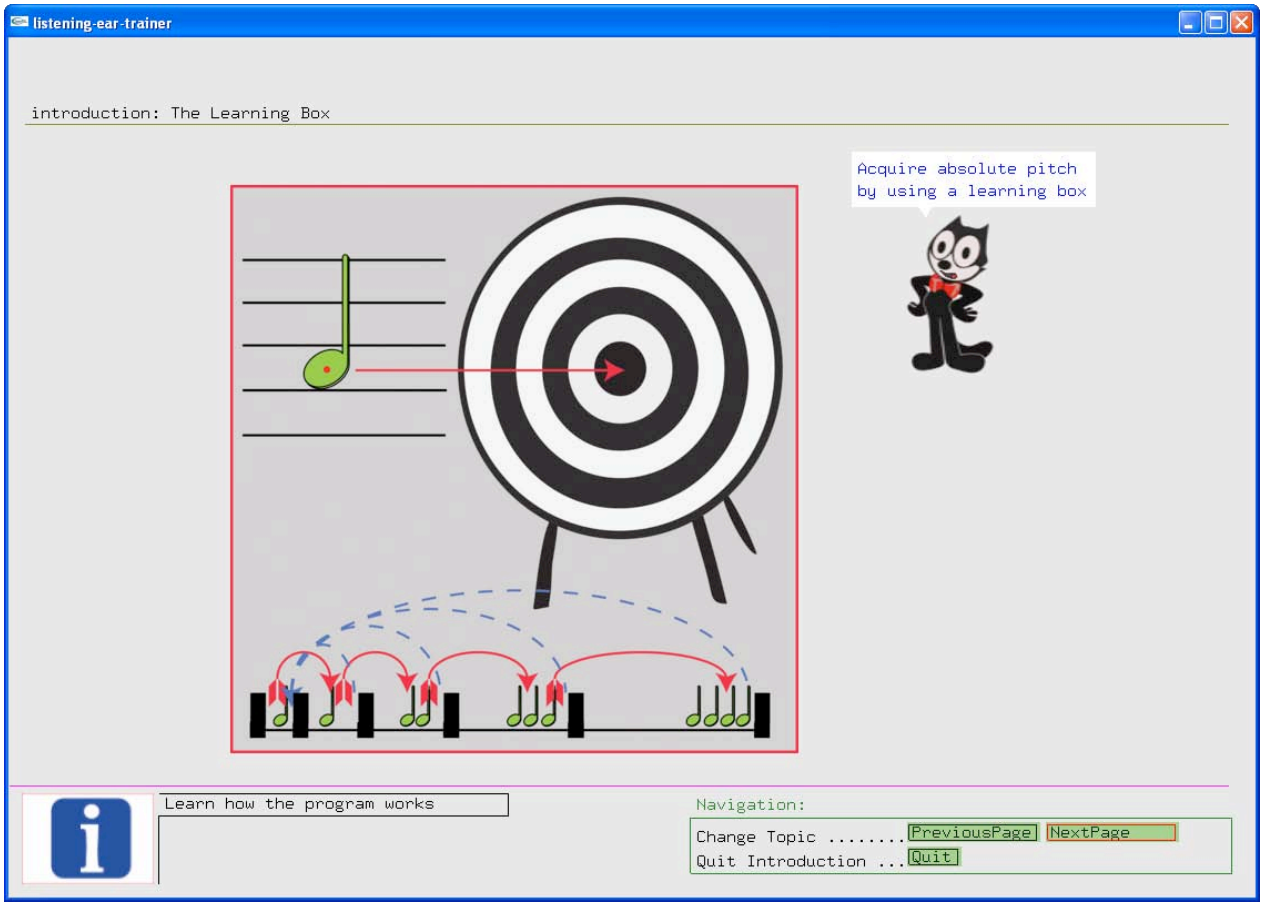
The exercises in this method will help you to repeat a pitch consistently and with increasing precision. Reaching a precision lower than 20 cents may require voice training because you need constant airflow and must avoid vibrato in order to produce a clean sound within the method's precision tolerance. However, a precision of 50 cents is sufficient to claim absolute pitch and should not require voice training.

In the lesson "Instructions" we will have a closer look at how the exercises work.

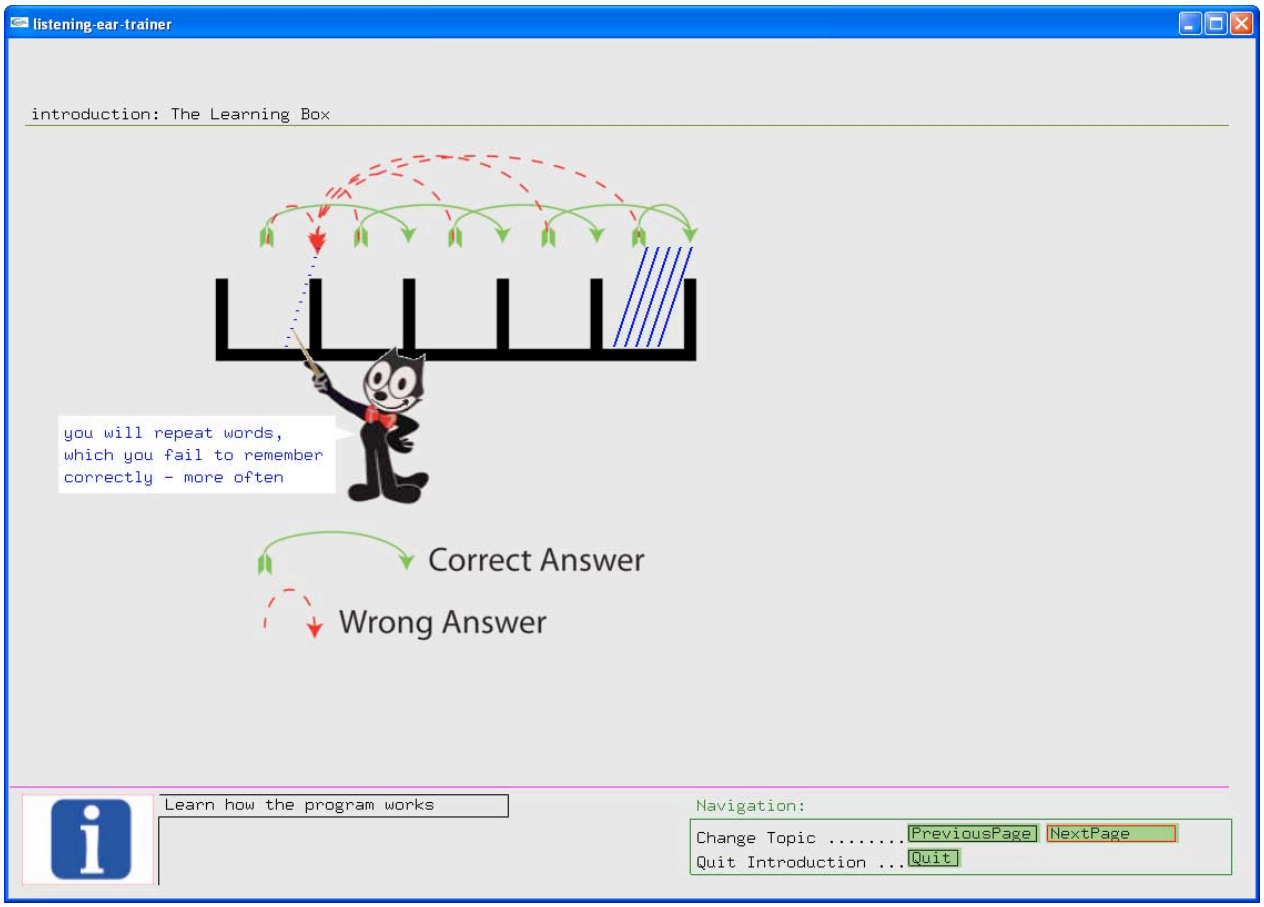
Instructions: Absolute Pitch

This lesson shows you how the exercises work.

The Singing Funnel exercises

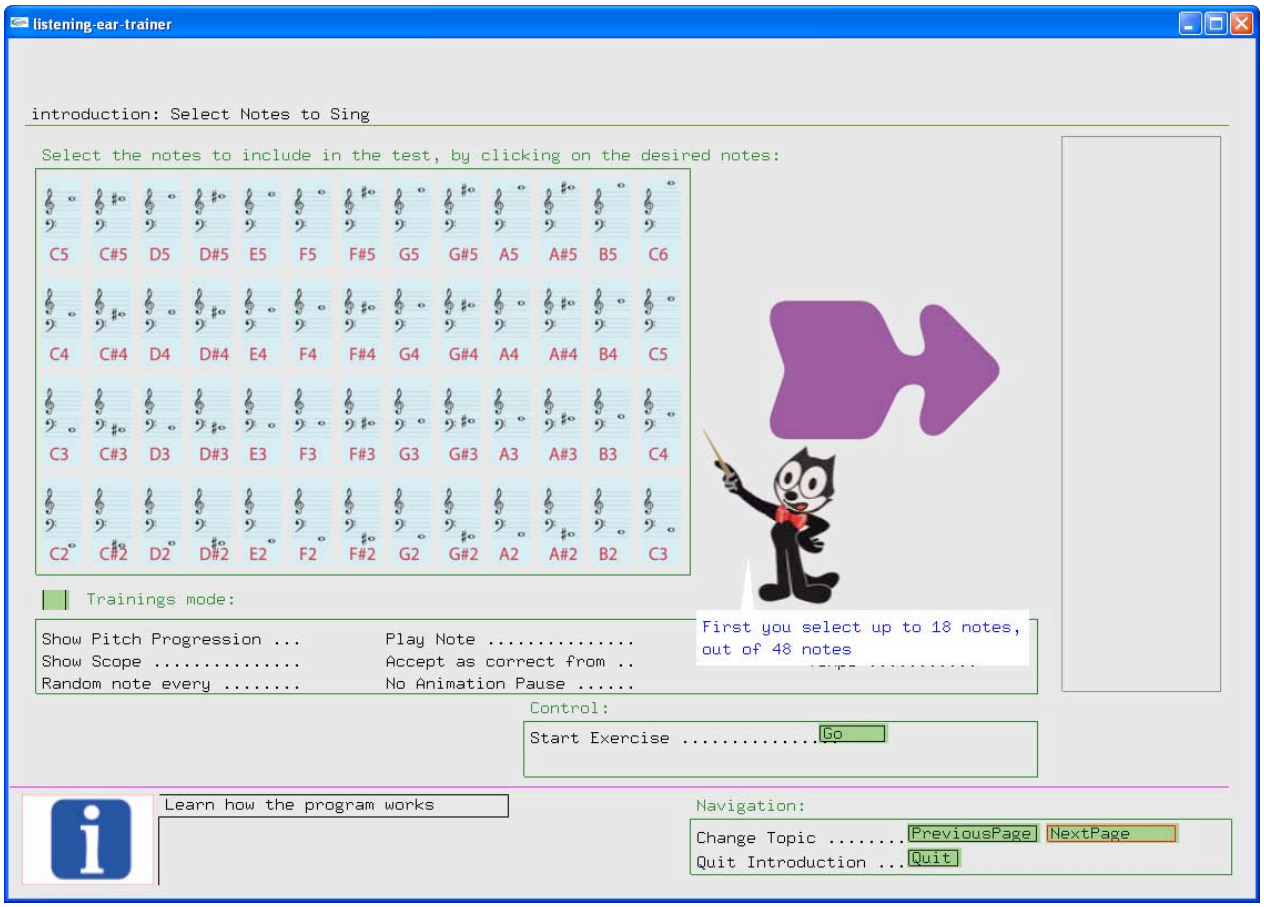


Similar to learning vocabulary for a foreign language, we make use of a “Learning box.” Instead of words, the Learning box contains pitch-sounds. However, since it is very hard to remember pitch sounds, we start by building muscle memory of vocalizing the sounds. That’s right! Instead of listening, you are asked to actively sing the notes as precisely as you can. Thus once you can produce sound-pitches correctly they move towards the last bin in the Learning box.



Incorrectly remembered pitches will go back to the first bin. In this way you will repeat sounds with which you have difficulty more often.

Since it is unlikely that you have a voice range of 4 octaves, we start by having you select a few notes you can hum comfortably.


listening-ear-trainer
introduction: Select Notes to Sing
Select the notes to include in the test, by clicking on the desired notes:
C5 C#5 D5 D#5 E5 F5 F#5 G5 G#5 A5 A#5 B5 C6
C4 C#4 D4 D#4 E4 F4 F#4 G4 G#4 A4 A#4 B4 C5
C3 C#3 D3 D#3 E3 F3 F#3 G3 G#3 A3 A#3 B3 C4
C2 C#2 D2 D#2 E2 F2 F#2 G2 G#2 A2 A#2 B2 C3
Trainings mode:
Show Pitch Progression ...
Show Scope .....
Random note every .....
Play Note .....
Accept as correct from ..
No Animation Pause .....
First you select up to 18 notes, out of 48 notes
Control:
Start Exercise .....Go
Learn how the program works
Navigation:
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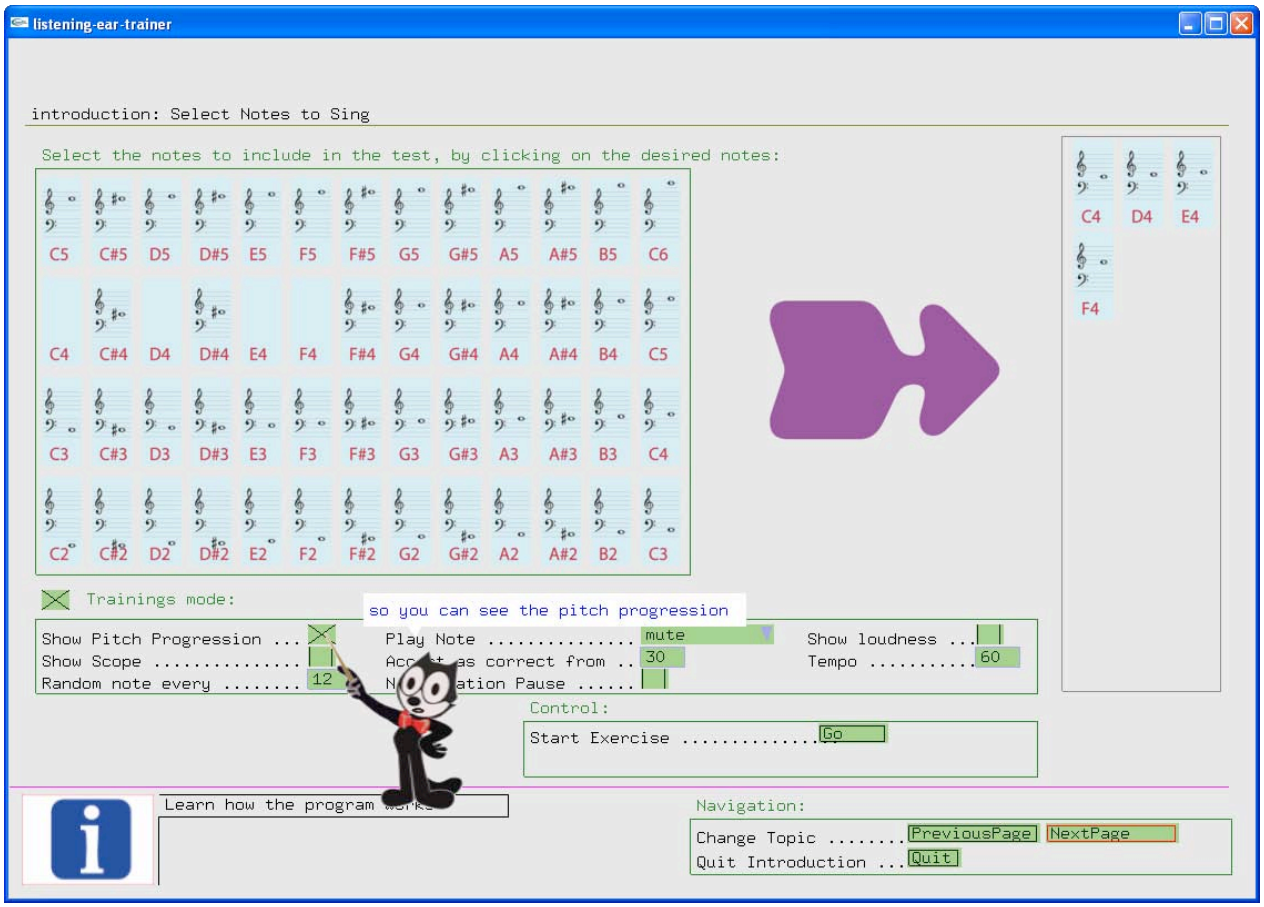
Until you have learned to produce the sounds correctly, it is recommended that you also choose the option: Show Pitch Progression. This will give you visual hints about your pitch and you can more easily learn to control your voice.


listening-ear-trainer
introduction: Select Notes to Sing
Select the notes to include in the test, by clicking on the desired notes:
C5 C#5 D5 D#5 E5 F5 F#5 G5 G#5 A5 A#5 B5 C6
C4 C#4 D4 D#4 E4 F4 F#4 G4 G#4 A4 A#4 B4 C5
C3 C#3 D3 D#3 E3 F3 F#3 G3 G#3 A3 A#3 B3 C4
C2 C#2 D2 D#2 E2 F2 F#2 G2 G#2 A2 A#2 B2 C3
C4 D4 E4
F4
Trainings mode:
so you can see the pitch progression
Show Pitch Progression ...
Show Scope .....
Random note every .....
12
Play Note .....
mute
30
Tempo .....
60
Control:
Start Exercise .....
Go
Learn how the program
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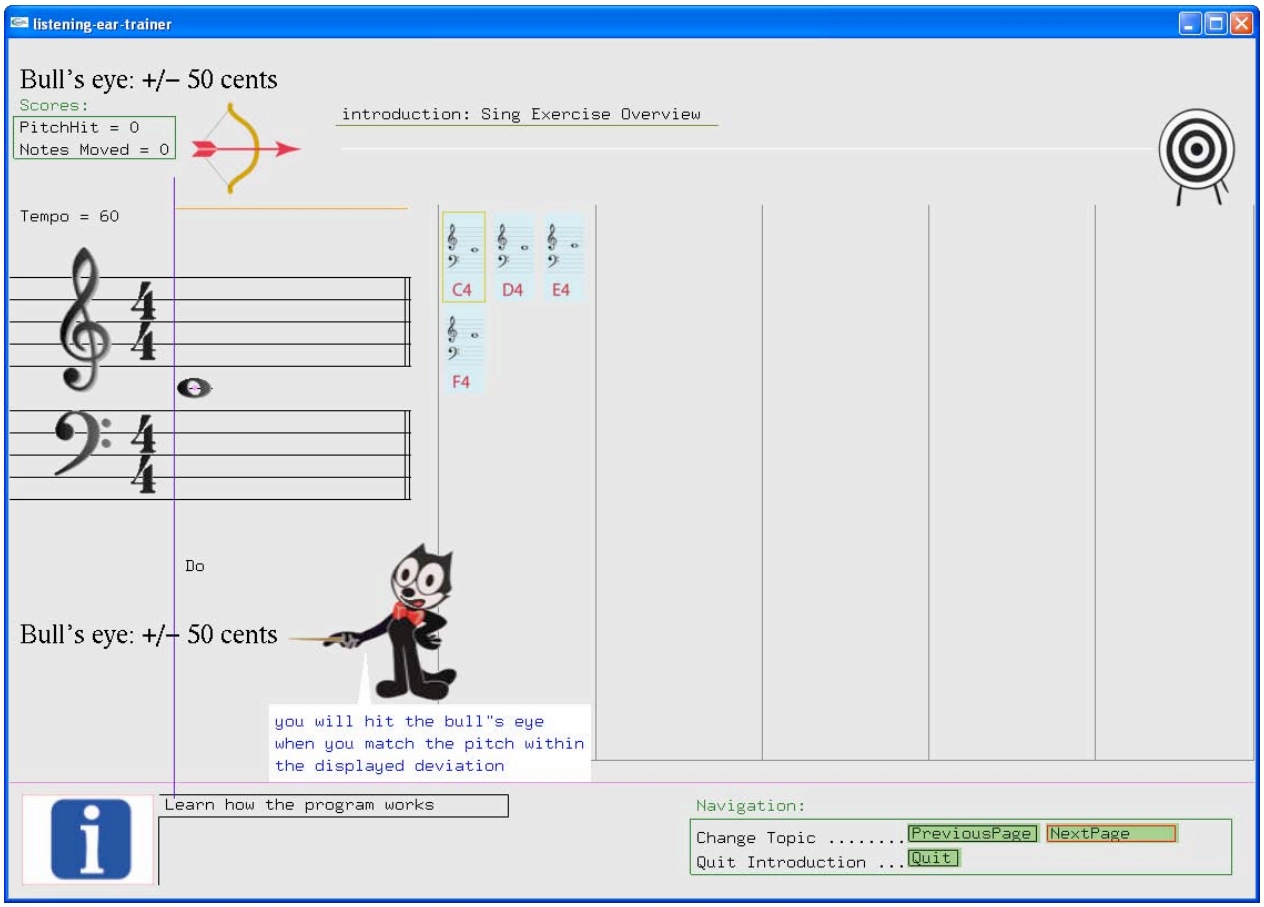
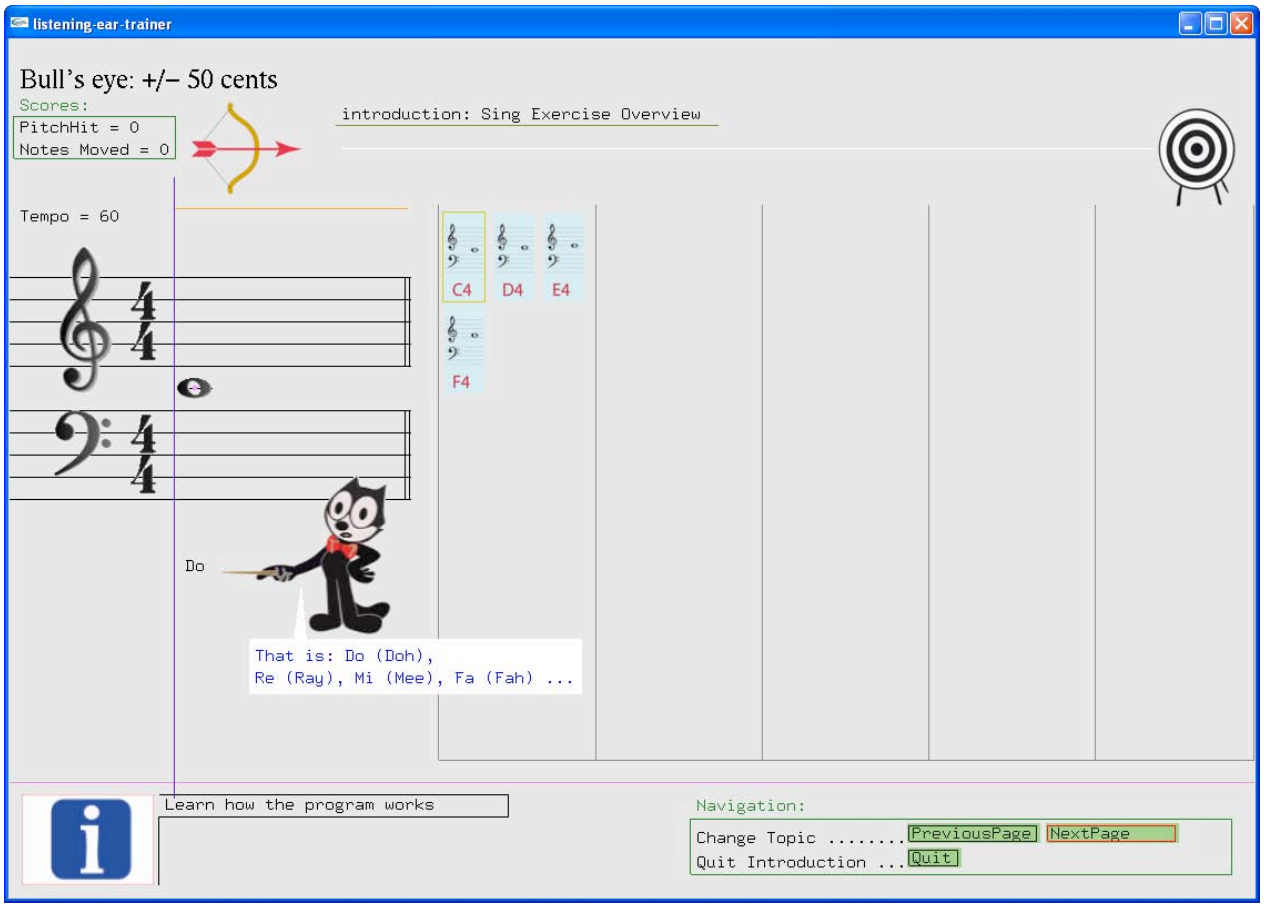
Quit

In the above sample the notes C4, D4, E4 and F4 were selected for training. After finishing the selection the following screen is presented:



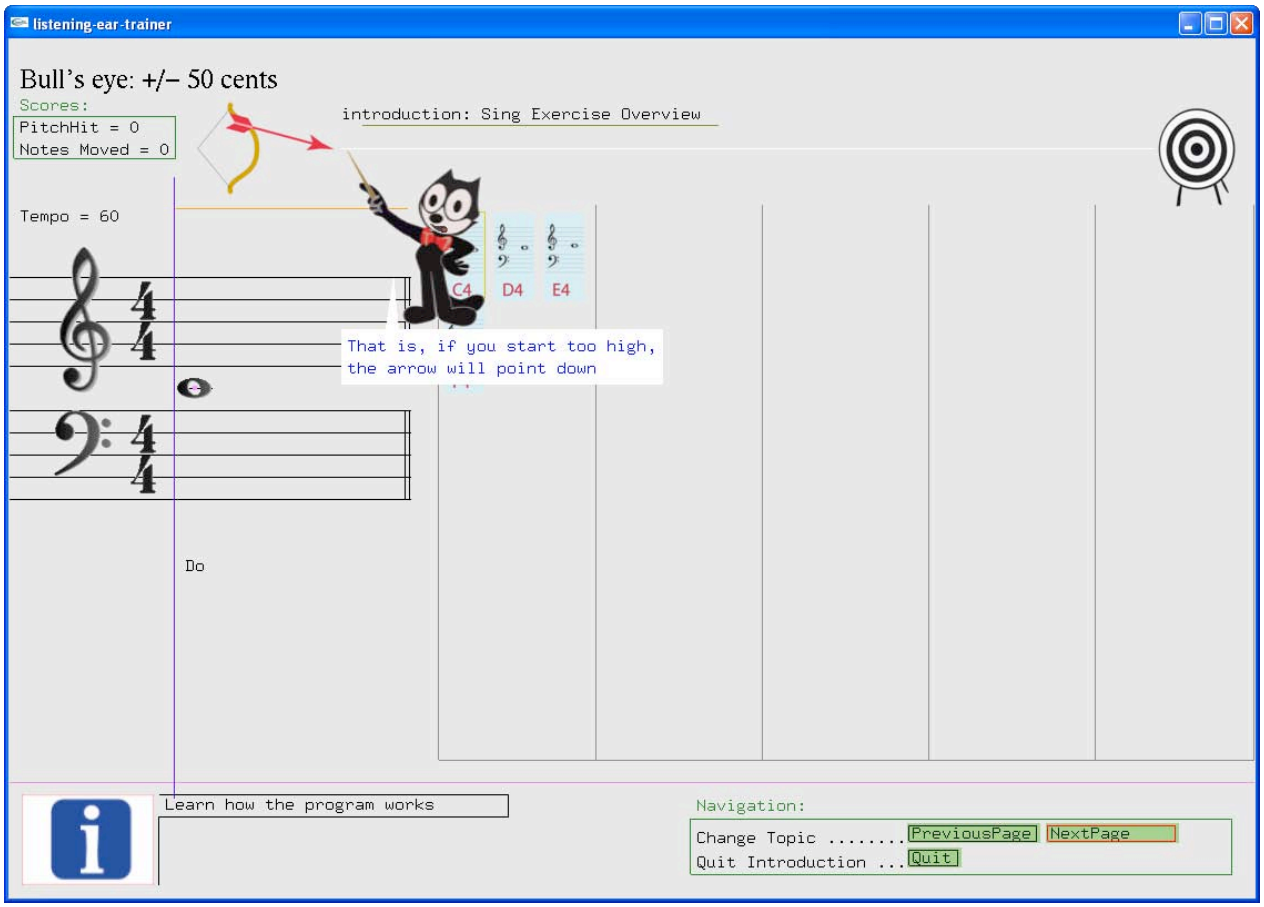
The exercise you choose sets the precision with which you must hit the pitch, all the way up to the bull's eye. So, the further down the singing funnel you get, the more precisely you have to sing the pitches.

To build an association of the pitches to sounds, we recommend that you sing solfège syllables: Do (Doh), Re (Ray), Mi (Mee), Fa (Fah), etc.



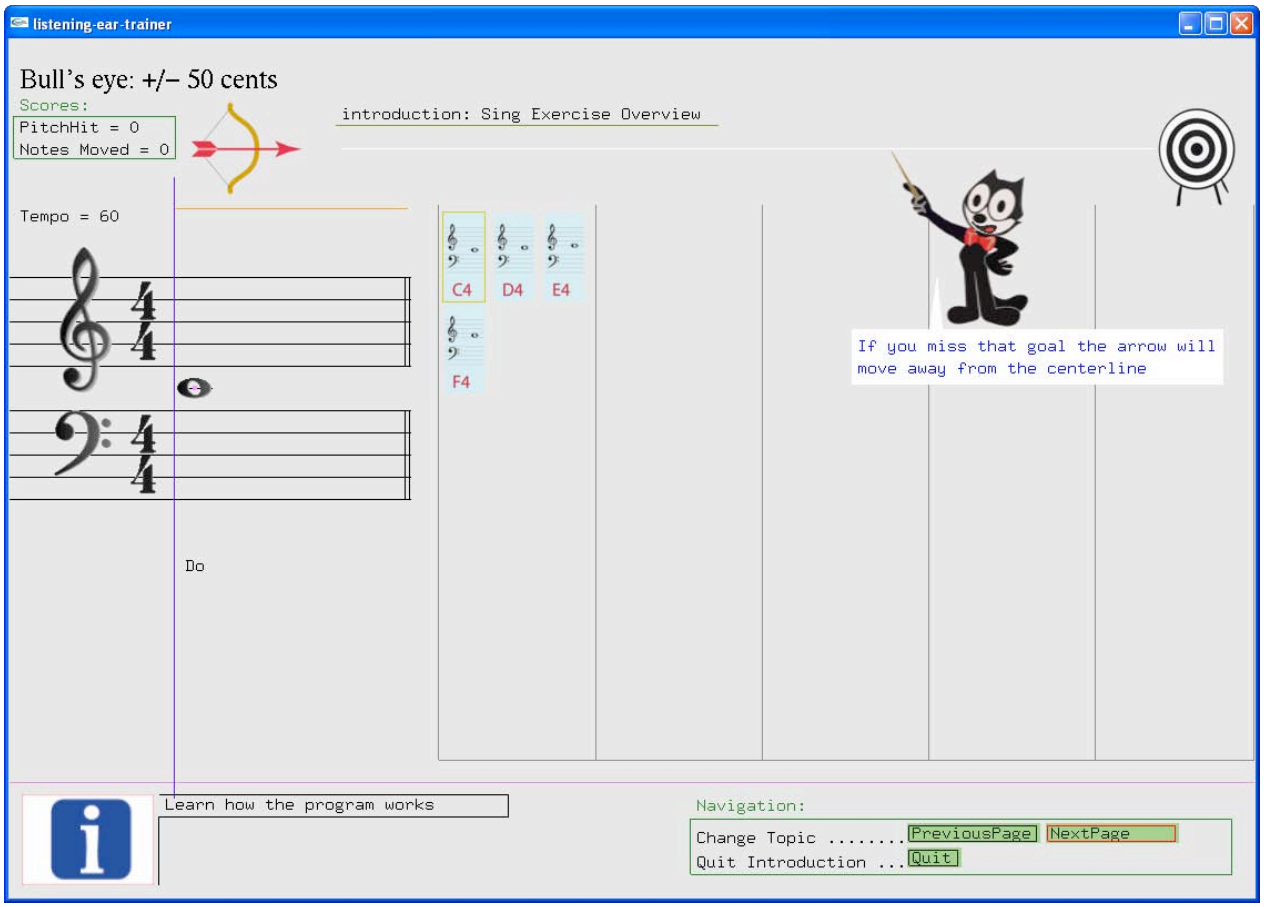
If you have chosen to do the training with pitch feedback, the solfège syllable is displayed for easier reference.

Since the program is evaluating your pitch memory, you should start singing during the count-off. This eliminates errors due to incorrectly placed tensing of the vocal cords. In this way when the pitch gets evaluated, you should have corrected your singing from what you imagined the sound should be.

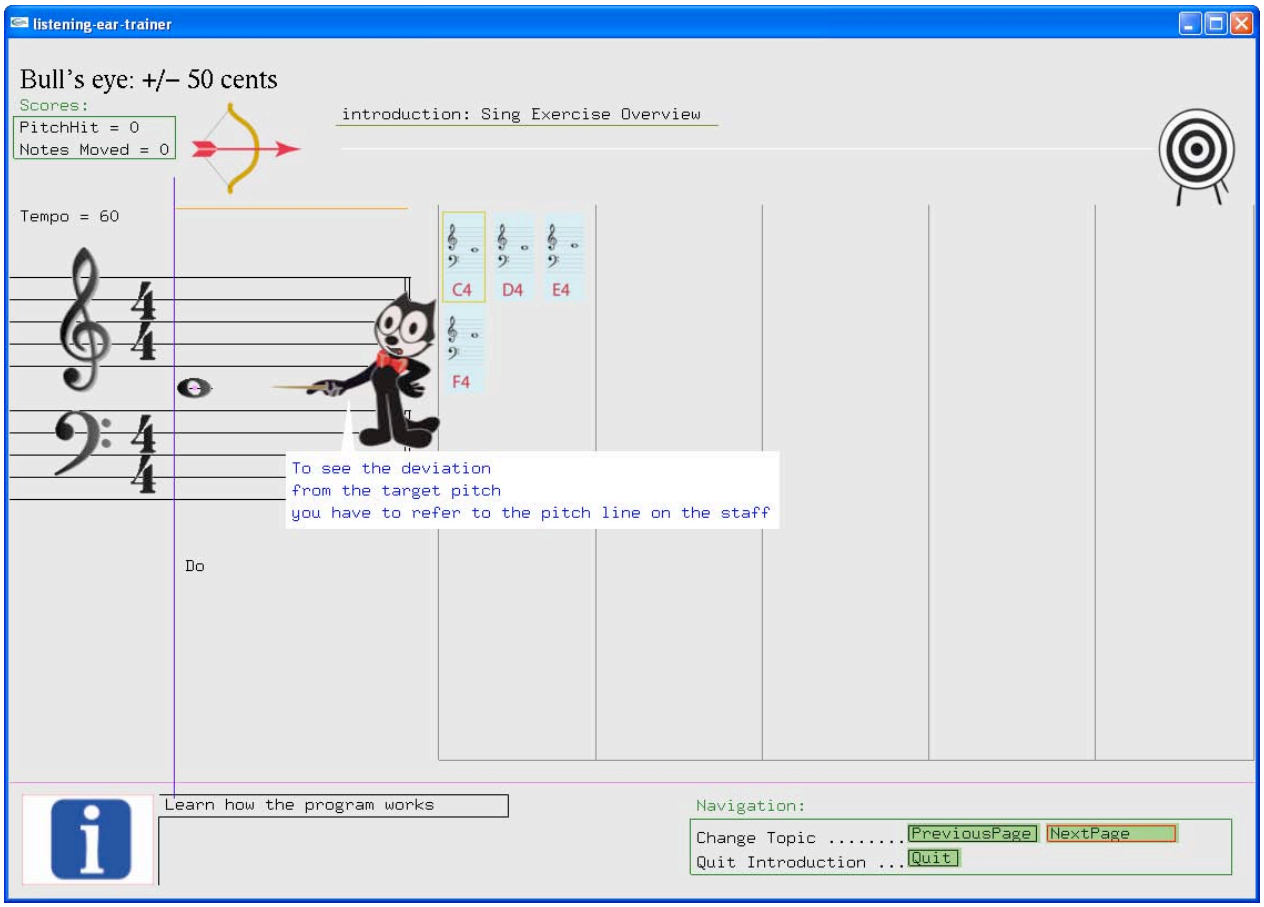


This first pitch shows where you thought the pitch should be. You can still slide to the correct pitch to get the correct feeling for that note, but the arrow will stay tilted. Thus the next time you would try to start singing this note higher or lower to meet the requirements.

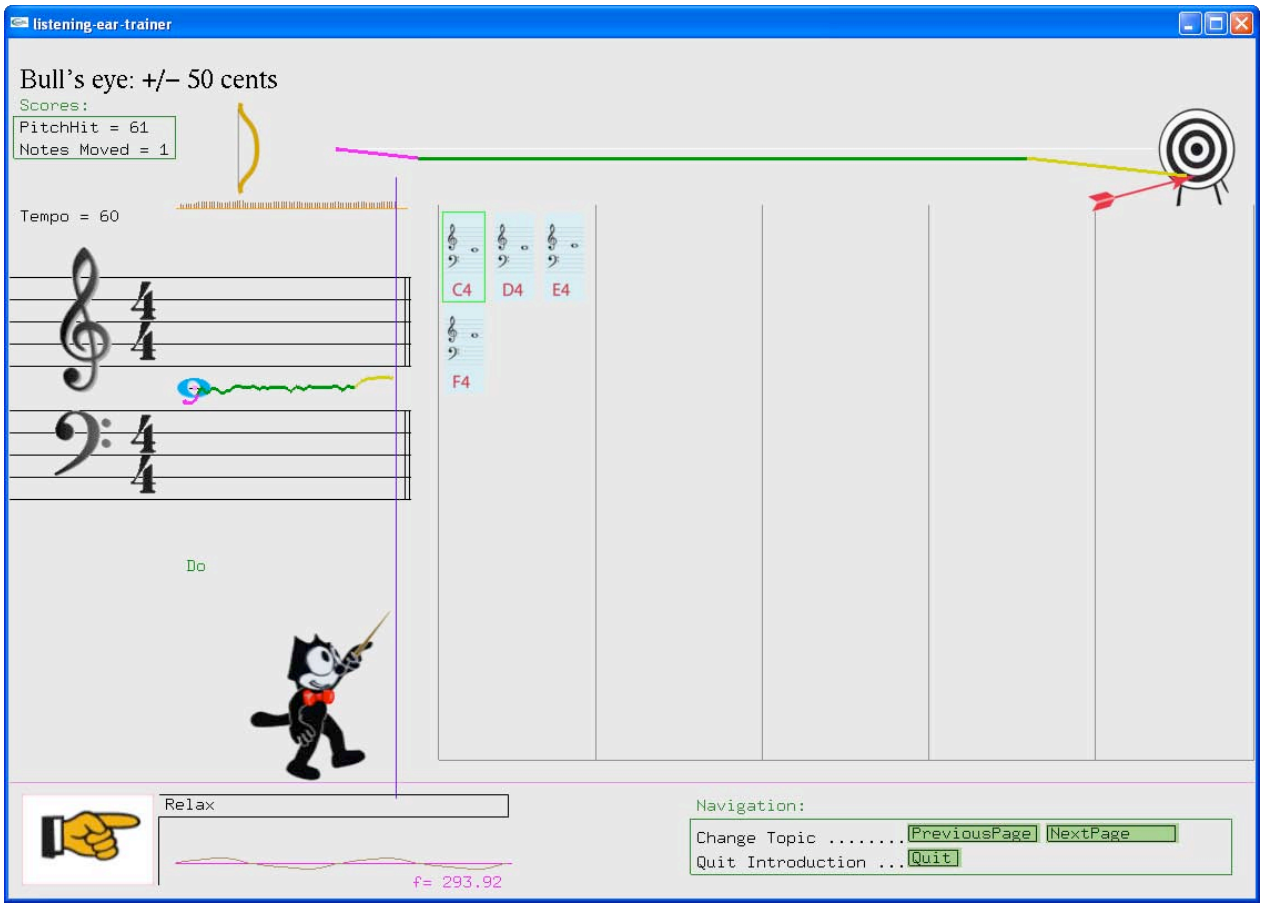
You have to hold the pitch for the duration given by the tempo. This will strengthen your understanding of where that pitch lies in your voice.



The trace line of the arrow will show the cumulated error. So if you miss the tolerance goal the arrow will move away from the centerline. Therefore, your goal is to always stay within the given tolerance.

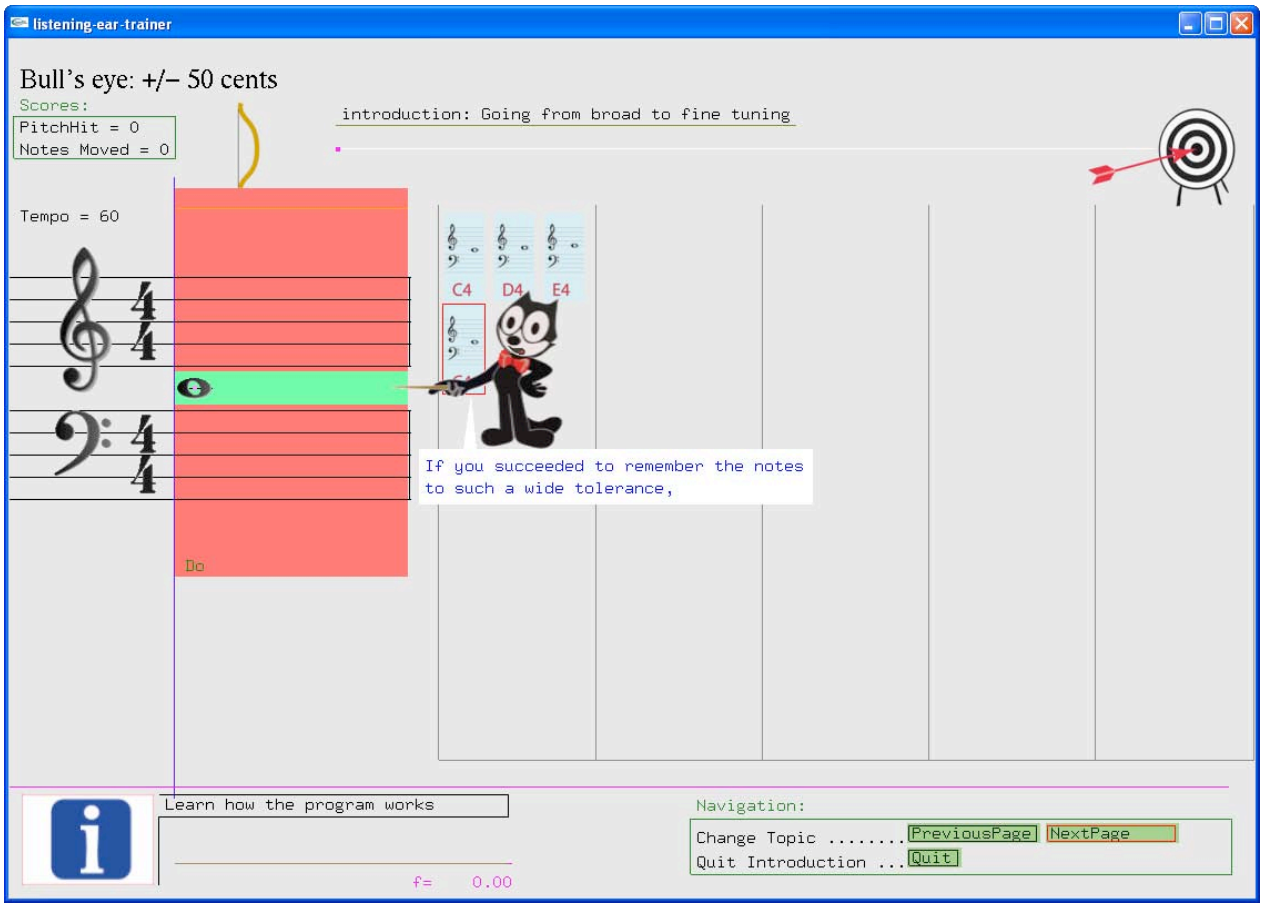


To see the deviation of the target pitch you must refer to the pitch line on the staff.



Here is a sample of a pitch, which started too low and then went up towards the end. Note the difference of the arrow trace line and the pitch line. Keep in mind that the pitch line is shown in training mode only. The arrow trace line is always shown. however, it is only shown from the beginning if you are in trainings mode. In test mode the arrow will always move in a straight line for the first few milliseconds before the display changes to show the detected pitches. That means you cannot use visual feedbacks in the test mode to reach your goal, but you should still try to correct any errors as soon as the visual feedback is shown.

As with Learning boxes for words in a foreign language, the goal is to move all the notes to the last bin. If you succeed in remembering the notes correctly, move on to the next lesson.



The Learning box helps you to improve your weak notes and your ability to imagine a sound. With each lesson the requirements increase, so the further down the singing funnel you are, the better you must remember the pitches.

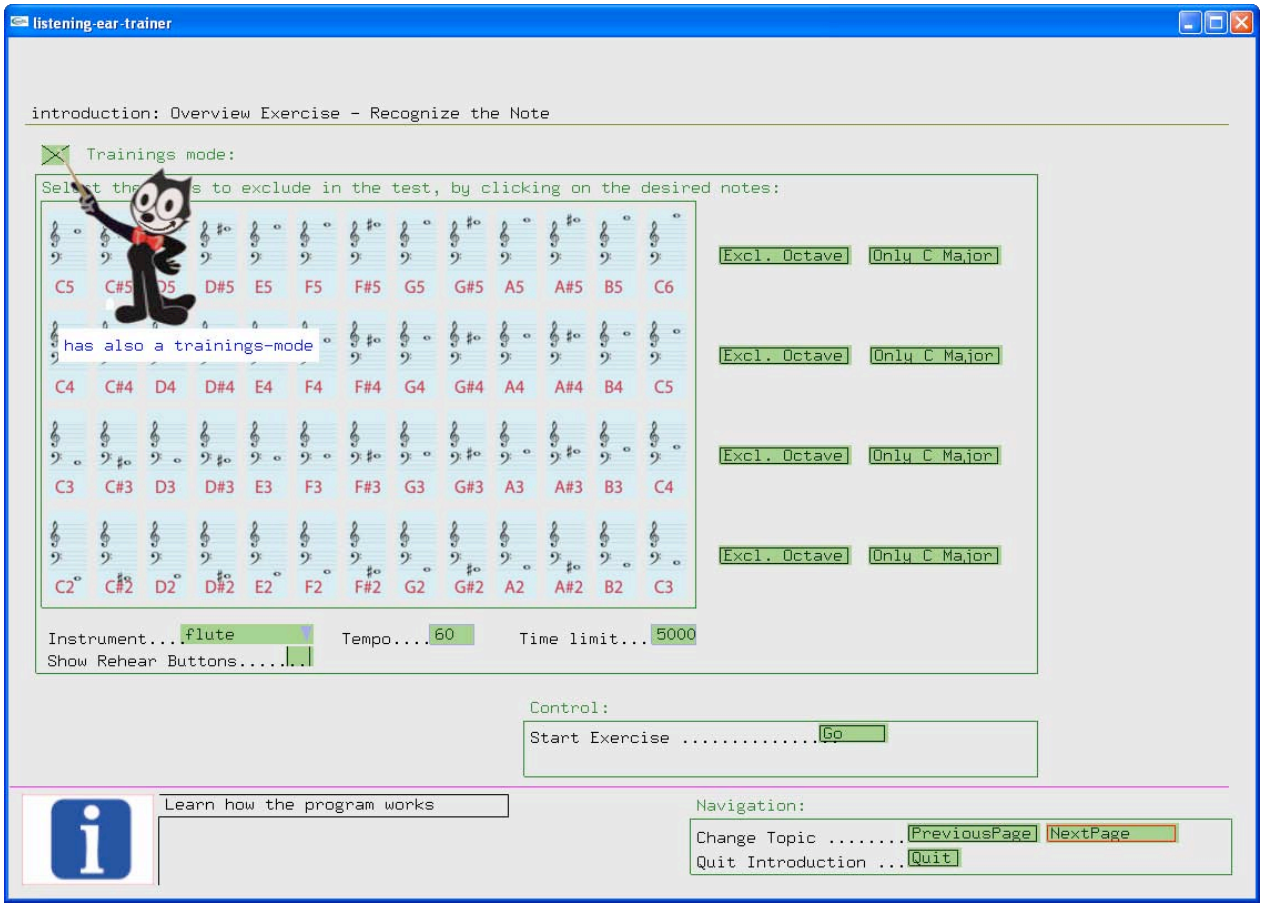
Attention: The aim here is not that you have to do all levels of precision. It is enough if you can produce the notes to a tolerance of 33 cents, which is better than the 50 cents required to claim absolute pitch. In this way you have some reserve and therefore can more confidently name the notes. To reach a precision of smaller than 20 cents requires voice training. In such training, you would learn to control your breathing more exactly, learn correct posture, and to relax your vocal cords using loosening exercises (e. g. singing rolling "R's" while going up a scale. To produce an "R" your vocal tract has to be relaxed and at the same time the movement of the tongue will encourage the blood flow). To reach the narrower precisions involves a great deal of training and time. We recommend that you do this only if you have a good reason to do so. Otherwise the required amount of time to reach that goal might lead to frustration. Keep in mind that singing to such a high precision can be quite mundane. Most songs deviate more or less from the optimal equal-tempered tuning and usually emphasize the natural just intonation; vibrato also gives a fuller sound. Perfectly sung songs would sound robotic, not human. Use your freedom to be creative within "allowed" limits. There may be one or two notes for which you will be able to reach a higher precision without special training. Use those notes as references for those more difficult to find.

The Octave Anchor Pitches exercises

Since you probably do not have a 4-octave singing range, but still would like to recognize all the notes in the range of C2 to C6, we have created the exercise. Recognize the Note.

This exercise will test your entire vocal range. However, if you have not had much formal training in recognizing pitches, this might be much more difficult. Therefore we have made separate exercises that guide you slowly in getting a feeling for the notes' absolute positions. The separate exercises include just the predefined sets of notes that help you to progress with the least amount of difficulty.

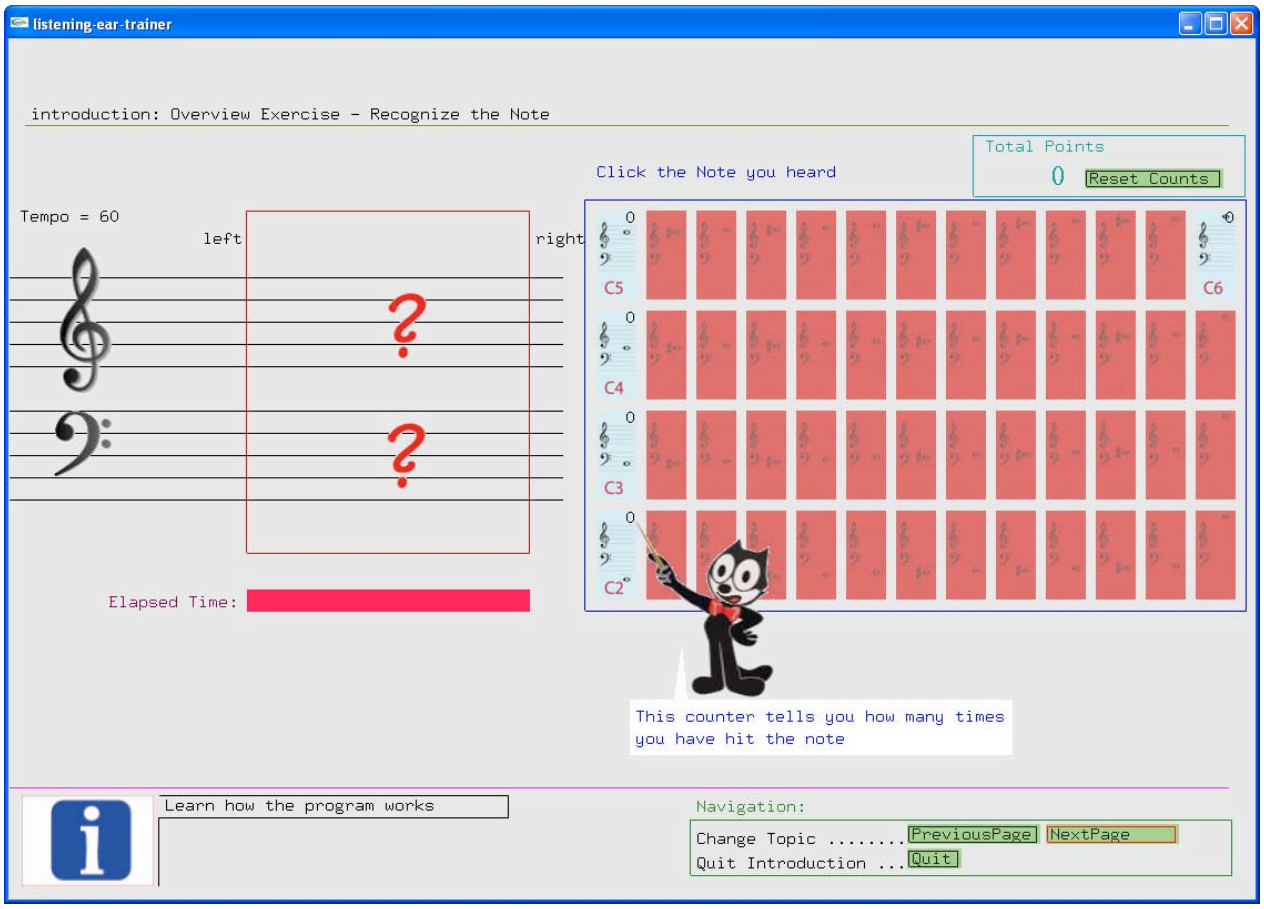
The exercises also have a training mode:



In the training mode, you can decrease the number of notes for the training. You can also decrease the tempo in order that the sound of the note lasts longer. You can also increase the time limit, so that you can identify the pitch's name at a comfortable pace. The training mode also allows you to set the instrument to voice, so the pitch is sung with the solfège syllable, making it simpler to guess the correct note.

The instructions show you how to set the options, so that they correspond to the first exercise: Recognize the Cs. For this exercise only the pitches for C2, C3, C4, C5, and C6 are selected.

When you start the exercise, the window will look like this:



You will hear one of the sounds randomly selected, and question marks will be displayed on the staff. On the right side all notes appear in boxes in the range of C2 to C6. Any unselected notes are covered by a red rectangle, but they all are shown in order to give you a better sense of where they are positioned. One of the goals is to improve your placement of pitches in the overall pitch range: as orientations “anchor points” help you sort out relative pitch errors. Thus if you sing other notes with relative pitch that is not perfect to the cent, your notes may drift away over time. If you have drifted away from the perfect pitches, these “anchor pitches” will trigger an alert if you cross them, so you can take correcting actions.

To measure your progress, each note-box displays a counter in the right upper corner. To strengthen the recognition process, each note must be answered 7 times correctly. Similar to the Learning box, incorrect answers will reset the hit count to zero.

In the first exercise the given notes are a whole octave apart in order to more easily identify the corresponding pitches.

You should not continue with the next lesson before you have mastered this one. These five notes build the anchor points for the lessons to come, and it is important to recognize these notes with confidence and ease.

The next lesson will add the strongest overtone of the note C: the perfect fifth, or the note G. Again, you should not continue with the next exercise before you have mastered the previous level.

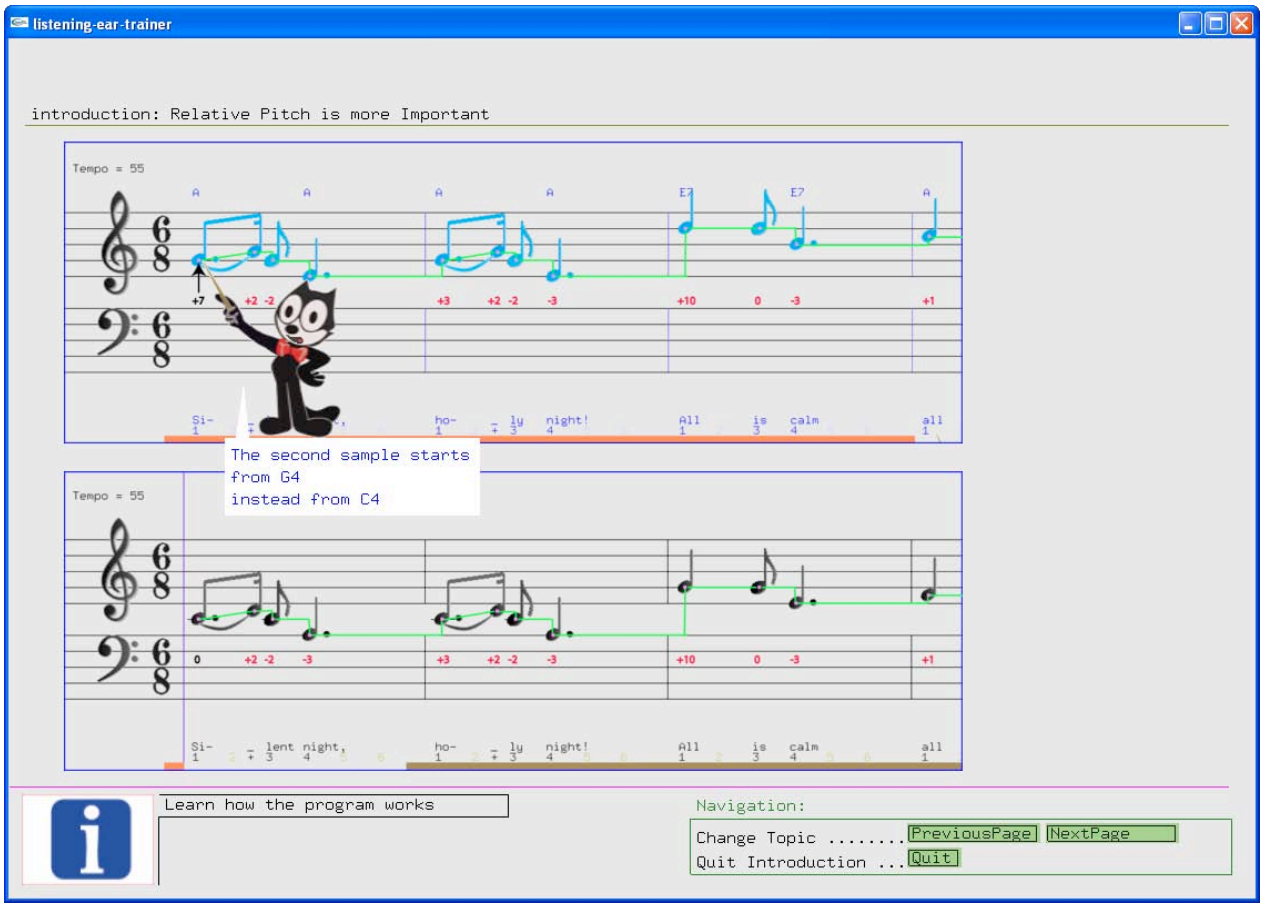
When you correctly identify the perfect fifth, you should have learned 9 anchor pitches. The next note to learn to differentiate is F. When we added the perfect fifth, or G, we immediately also added its inverted note, the perfect fourth, or F. Therefore, you have already heard this overtone in the tones you have mastered. Next you must learn to differentiate the pitch as a pure pitch and distinguish it from overtones of the Cs and Gs.

As more notes are added, your brain must begin to look for better ways to differentiate the notes as its limitations in recognizing a new sound become apparent. The brain searches for solutions in what it has already stored in memory, by relating to sounds it can remember and that have a connection to a particular pitch.

If you try humming a pitch in a manner that where you longer compare its sound to other notes, you are on the right track! Now, go back to the Singing Funnel method. With this method you learn to control the production of your pitches. Start with a pitch you can hum comfortably. You will likely be correct. We strongly believe that, at one point, the brain feels the urge to hum the pitches through its muscle memory, the best place to store single-pitch hearing experiences. (This need not only mean that because you can hear a whole song in your head you have a musical memory. There the memory is instead built on interferences between the sounds of different instruments. Because more than one pitch is involved the relative distances between the sounds make the musical feeling.)

As for relative pitch, if you do any absolute pitch training exercises here, chances are that you will also be training in relative pitch. Since the brain gives you the correct answer based on the previous note you are no longer training in absolute pitch.

To demonstrate relative pitch, the well-known song “Silent Night” is played twice.



The only difference between the two given sample recordings is the starting note. In both samples the notes following use the same relative pitch difference from the previous note. Even so, the notes are different, and you will easily recognize either melody as Silent Night from Franz Xaver Gruber. Absolute pitches become almost meaningless in the process of melody recognition.

This sample also highlights your sense of relative pitch. Ear training will improve your sense of relative pitch, which is good. As we have intimated earlier—relative pitch is more important than absolute pitch.

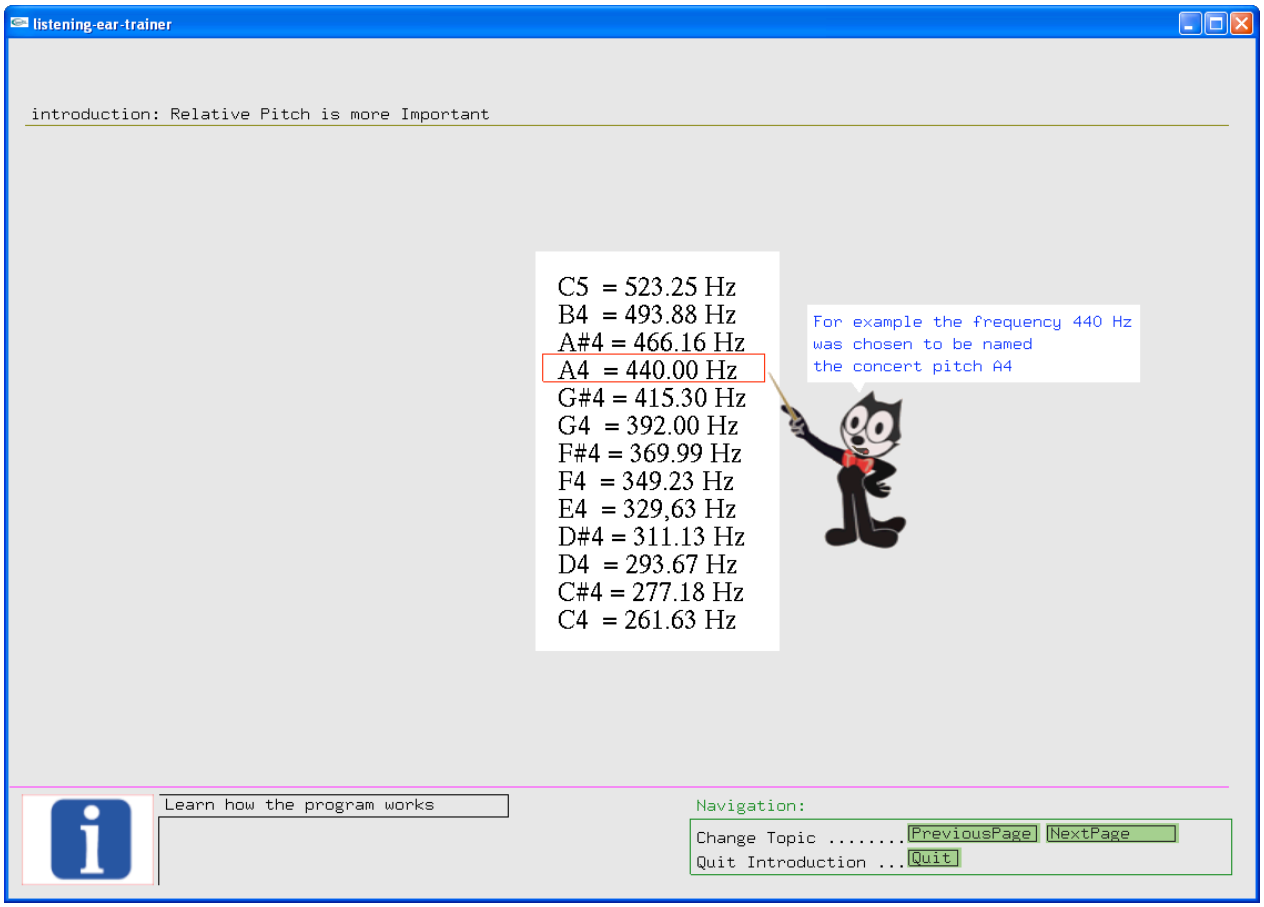
To further understand why relative pitch is more important than absolute, not only on a note by note basis, consider the following scenario: say you should accompany a flute, which plays the lead melody, with your guitar. Assume also that the flute cannot be tuned on the fly (e. g. pan-flute). Imagine also that, unfortunately, it is a very hot day. The temperature influences the sonic speed of the air and thus the pitch or tuning of the flute: the increase of sonic speed by the temperature makes the flute produce higher frequencies. The length of expansion of the flute's bamboo tubes compensate for this effect to some degree by making its air-pipe longer, thus this effect lets the flute produce lower sounds. But the effect of the expansion is not enough to compensate the pitch increase through the increase of the sonic speed, and thus the flute deviates from perfect tuning. Since all notes of the flute are affected, all notes will sound higher.

The guitar on the other hand tends to produce lower pitches, since the expansion of the strings is larger than the expansion of the neck.

As demonstrated with the product Listening Music Teacher, differences between simultaneously played notes, can be easily heard because the interactions produce an overlapping dynamic effect. So when the flute and the guitar play the same note (the flute a little bit too sharp and the guitar a little bit flat) you will recognize an increase and decrease of the loudness of the combined sounds with a low frequency. If these effects are small it does not seem to hurt the overall experience of the music. But if as a musician you can hear such subtle differences, you are advised to tune your guitar to the flute (even so the flute is off the equal-tempered tuning). Instruments that harmonize in tune sound much better than those not in tune. A tuning fork, perfectly pitched to the equal-tempered scale, will not solve a tuning problem between instruments. You must listen instead to the flute, when, because of the weather, it has gone off its equal-tempered tuning.

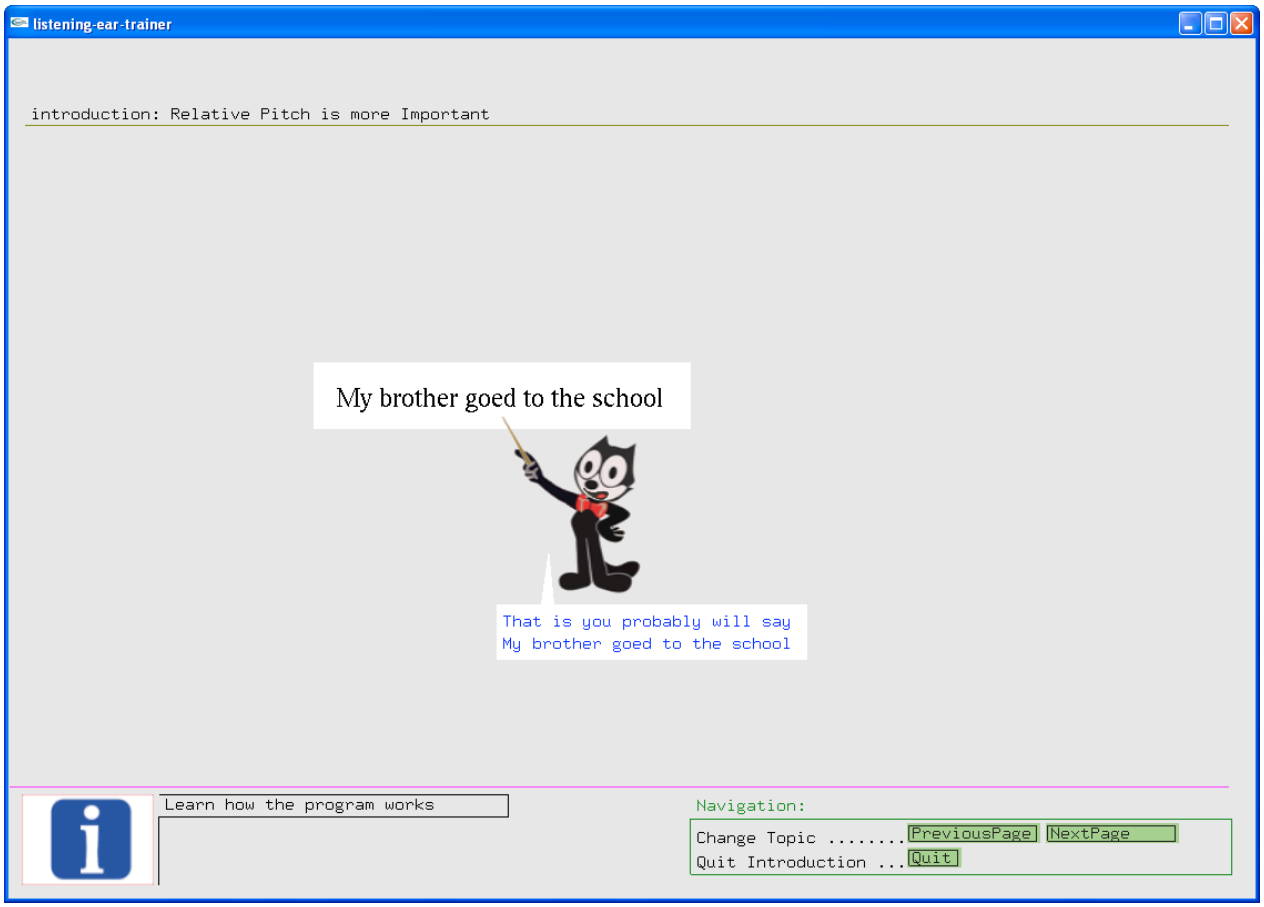
A side remark to avoid confusion: The increase of the sonic speed of the air does not change the frequency during transportation of the sound. That is a source producing a sound of 390 Hz will be heard at a distance of 10m still as a frequency of 390 Hz. Just a little bit earlier since the sonic speed bring the sound waves faster to the remote point. But for the production of the frequency within the flute, the sonic speed is important. Because the knot of the sound wave reaches the reflection point in the tube faster the produced frequencies will be higher. On the guitar the strings produce the frequency. The guitar body has the task to resonate and amplify the sound, thus is not responsible for the production of the intended sound. Therefore, the sonic speed has little effect on the frequency generation in the guitar.

This preference of harmony over absolute pitch probably explains why, in the West, absolute pitch is rare.


listening-ear-trainer
introduction: Relative Pitch is more Important
C5 = 523.25 Hz
B4 = 493.88 Hz
A#4 = 466.16 Hz
A4 = 440.00 Hz
G#4 = 415.30 Hz
G4 = 392.00 Hz
F#4 = 369.99 Hz
F4 = 349.23 Hz
E4 = 329,63 Hz
D#4 = 311.13 Hz
D4 = 293.67 Hz
C#4 = 277.18 Hz
C4 = 261.63 Hz
For example the frequency 440 Hz
was chosen to be named
the concert pitch A4
Learn how the program works
Navigation:
Change Topic .....PreviousPage NextPage
Quit Introduction ...Quit

Our intelligent Western brain has not yet found a good reason to learn absolute pitch. Unless, as a child you were exposed to pitch exercises, or musical training in any form, our society hands out no rewards for having absolute pitch. Absolute pitch becomes only a relation between a frequency and a name. For example, the Stuttgart Conference of 1834 recommended the frequency of 440 Hz as the concert pitch A4 (see http://en.wikipedia.org/wiki/Concert_pitch).

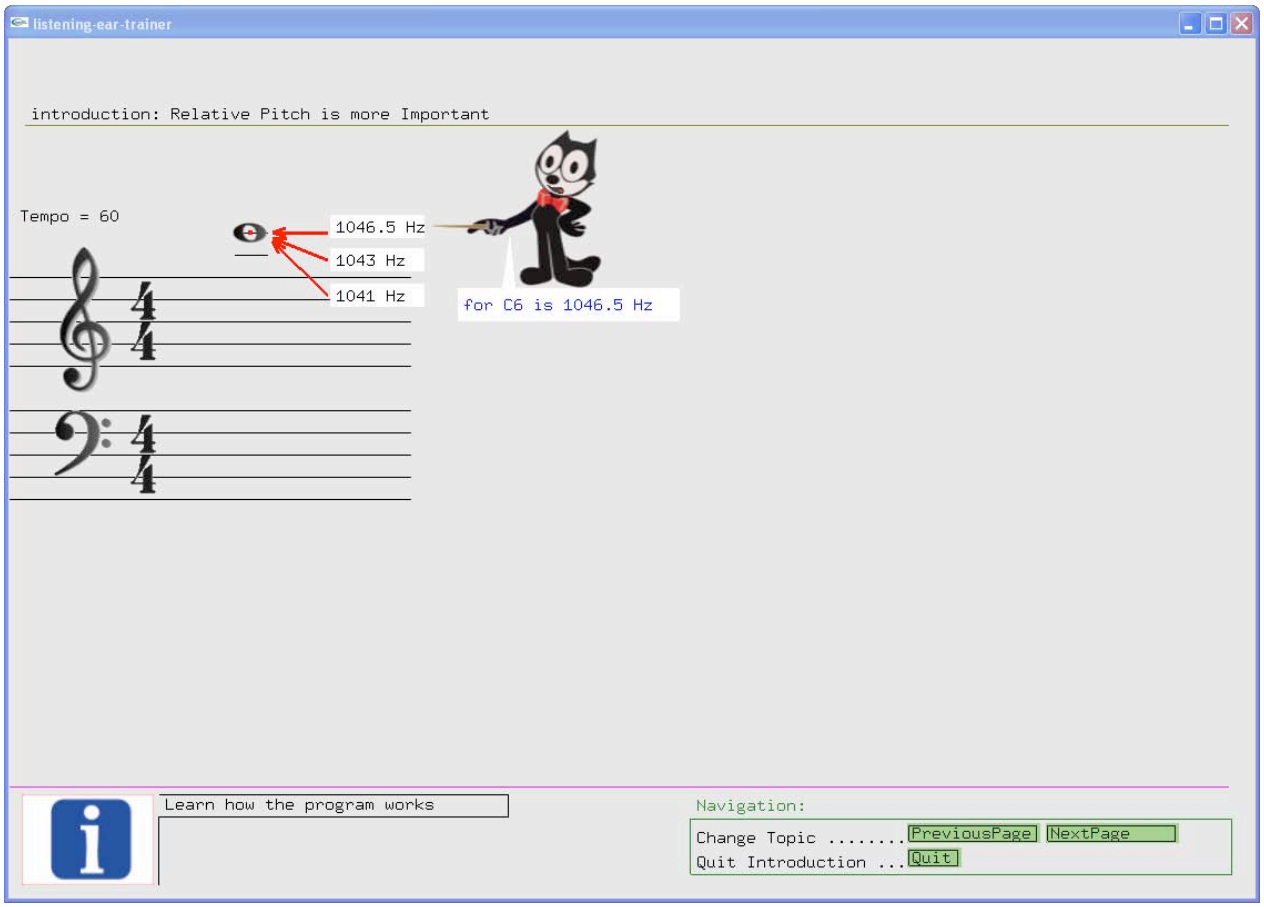
In contrast, relative pitch helps you to stay in harmony with others. Our brain prefers to generalize concepts and then to apply these concepts afterwards.


listening-ear-trainer
introduction: Relative Pitch is more Important
My brother goed to the school
That is you probably will say
My brother goed to the school
Learn how the program works
Navigation:
Change Topic .....PreviousPage NextPage
Quit Introduction ...Quit

For example, as a child you go through a stage in which the brain generalizes grammatical rules. Thus you might say: “My brother goed to school” instead of “My brother went to school.” The brain has yet to learn exceptions, and does so in a separate effort.

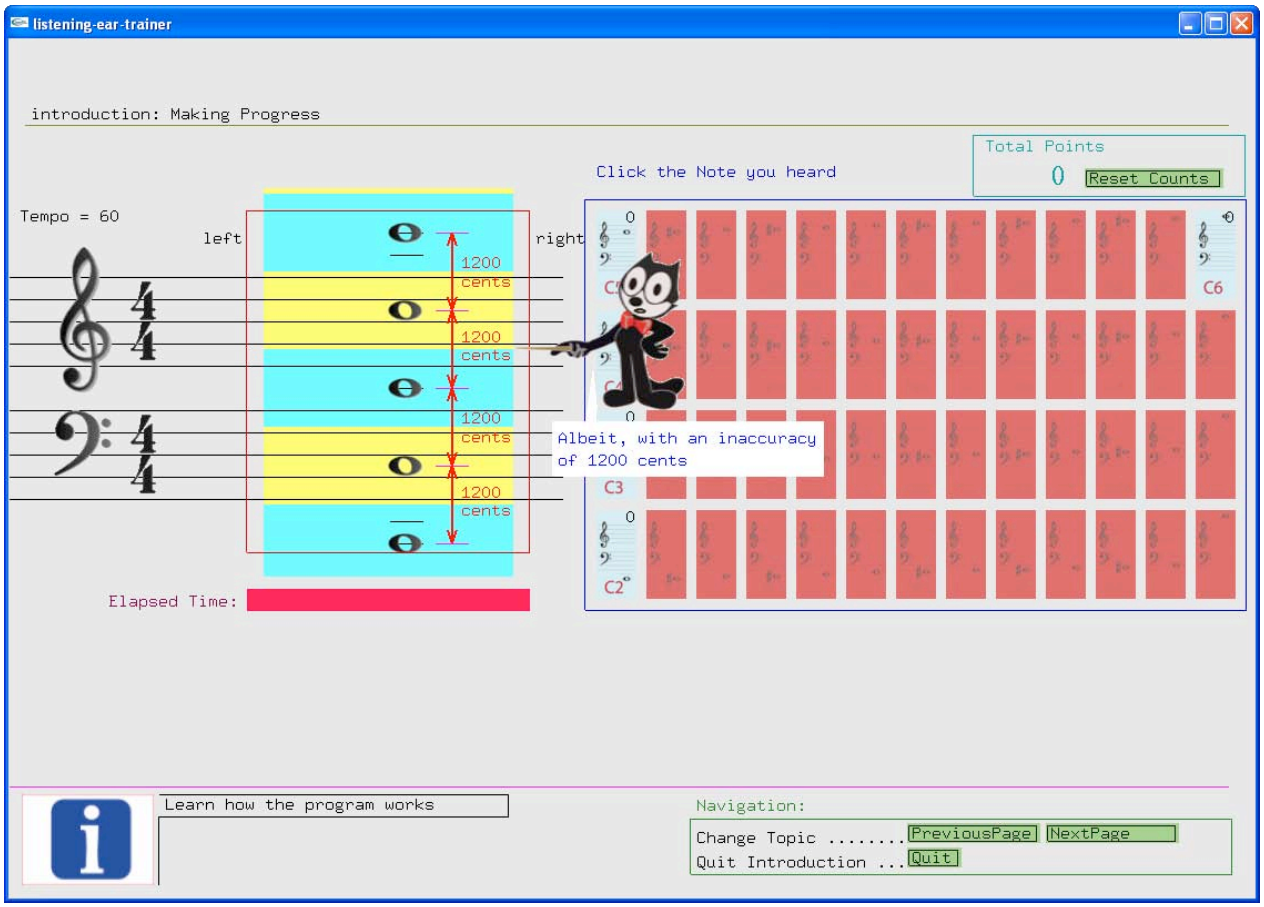
Relative pitch is a general concept used in music systems throughout the world. It is based on physical laws: The starting frequency determines the overtones, which harmonize with that frequency. The key center of a particular piece will outline all the notes we might use in order to stay within the harmony of the piece.

To detect a frequency and assign it a name is just a naming process that need not include that frequency’s relation to other notes. Thus if you could detect the frequencies to a precision of 1 Hertz, there would be no need for note names. You could simply identify pitches using the physical unit of a frequency.



If you can differentiate two pitches that are only 1 hertz apart, and the time between these two sounds is an hour apart, then you truly have a sensational ear. People with absolute pitch would say that the pitches of 1041 Hz and 1043 Hz correspond to the note C6. Even so the exact frequency of C6 in the equal-tempered tuning system has been calculated as 1046.5 Hz.

Despite the emphasis of relative pitch, using absolute pitch to differentiate pitches into ranges helps to keep track of the entire sound spectrum of pitches.



Absolute pitch training might be boring or frustrating, so you almost certainly will want to fall back on relative pitch training. To train in absolute pitch requires you to interrupt your training, for about 15 minutes. By doing these interruptions you can be sure that your absolute pitch recognition process gets practice – and not the relative pitch recognition process. The main difficulty will likely concern recalling the sounds. However, if you train with the Singing Funnel method, you will see that you indeed can memorize sounds very precisely. Rather than playing a guessing game, you will incrementally improve your listening abilities and begin hearing the sound even before it gets produced. This conceptualizing of notes will improve your mental ear. Finally, if you can sing the pitches with an accuracy of 33 cents, you will have gained enough confidence to assign a pitch the corresponding note name—and thus have gained absolute pitch.

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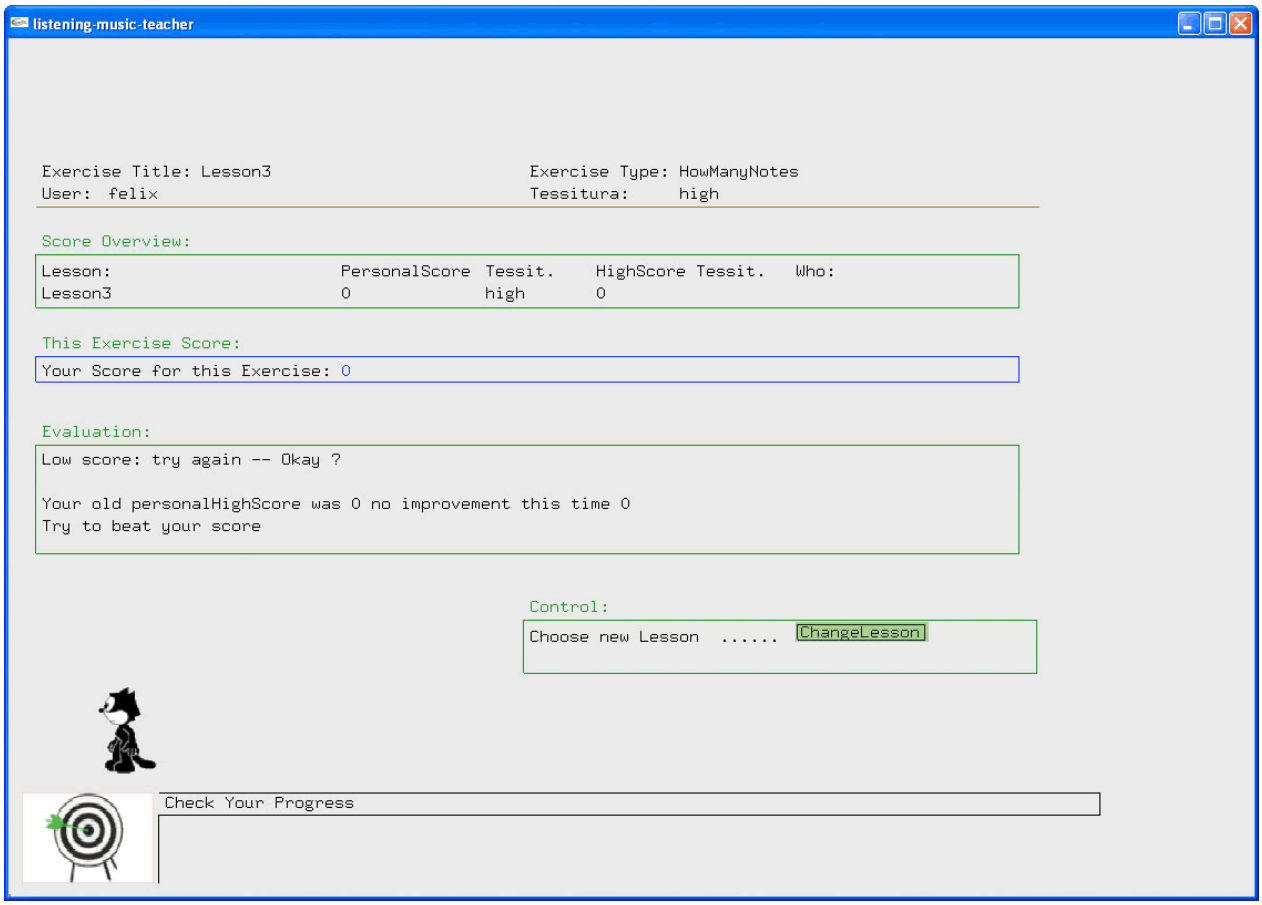
Exercises: Absolute Pitch

The first exercises, entitled “Absolute pitch ... “ cover the Singing Funnel method. During these lessons you must sing the note in response to the question; the evaluation is based on the pitch being sung within the required tolerance.

The exercises “Recognize the Cs” until “Recognize the note” cover the Octave Anchor Pitches method. Your task is to click the button that matches the pitch you heard.

The score for the exercises continue indefinitely. That is, when you start a specific level, you are supposed to do 25 exercises. However, your score does not start from zero. Instead your score will continue from where you left off. There are a maximum number of points you can make in each level, but to reach the maximum is not the goal per se. Ear training is a continuous process, just like learning a foreign language.

We will start explaining the exercises shortly, but first we will show you the common procedure after an exercise. Once you have finished an exercise, you will automatically be transferred to the feedback screen:



In the middle of the feedback screen you will find the score you reached for a particular exercise. The scores are colored as follows:

- blue: You reached less than one third of the possible points
- green: You reached the basic level
- yellow: You reached more then two thirds of the possible points
- red: You have more then 90 % correct answers

Below that you will see your previous high score, and a comment to keep on improving.

The scoring allows you to track your progress. If several users are using the program, the person with the highest score is also listed. Take this challenge as an invitation to get better. You can also make two or more profiles for yourself: for example a morning user and an evening user. In this way you can compare your performance depending on the time of day.

The Singing Funnel Exercises

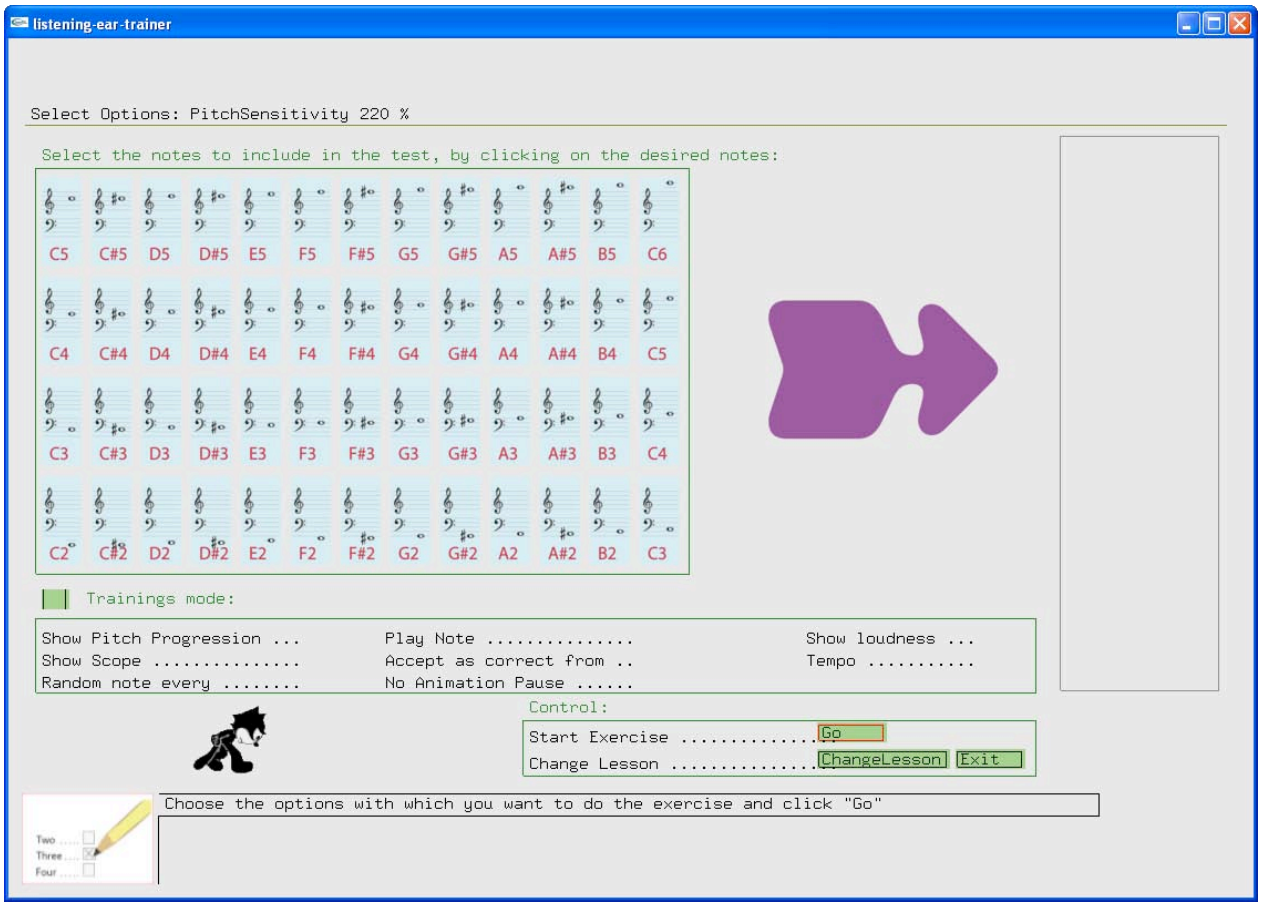
The Singing Funnel exercises are organized in levels. Each level stays for a precision you have to reach. In each level there are 6 exercises: The first exercise in each level ask for only 2 notes to be sung; then the following exercises add more notes: 3, 5, 8, 13 and finally 18 notes. If possible, you should expand your notes-vocabulary to a whole octave, before continuing to the next level.

Absolute pitch 480 cents

This exercise is the entry point to the funnel. Your task is to conceptualize the first note in the "card deck"; that is, to hear it in your head, and then adjust your vocal cords to produce the desired sound.

But before you can start the exercise, you have to select some notes. We recommend that you start with a few notes you can sing comfortably. You can add or remove notes any time, by selecting the "Show exercise options" in the lesson's dialog box before starting the lesson.

The exercise options for the "Absolute pitch … cents" exercises are:


listening-ear-trainer
Select Options: PitchSensitivity 220 %
Select the notes to include in the test, by clicking on the desired notes:
C5 C#5 D5 D#5 E5 F5 F#5 G5 G#5 A5 A#5 B5 C6
C4 C#4 D4 D#4 E4 F4 F#4 G4 G#4 A4 A#4 B4 C5
C3 C#3 D3 D#3 E3 F3 F#3 G3 G#3 A3 A#3 B3 C4
C2 C#2 D2 D#2 E2 F2 F#2 G2 G#2 A2 A#2 B2 C3
Trainings mode:
Show Pitch Progression ...
Show Scope .....
Random note every .....
Play Note .....
Accept as correct from ..
No Animation Pause .....
Show loudness ...
Tempo .....
Control:
Start Exercise .....
Go
Change Lesson .....
ChangeLesson
Exit
Choose the options with which you want to do the exercise and click "Go"

From the entire block of 48 notes you can choose up to 18 notes. In fact, to reach the maximum points possible, you have to select 18 notes. But be careful not to run before you know how to

walk. Start slowly and add notes as you progress. You will have to make these selections for all levels, so you might select different sets of notes at each level.

Choose only notes you can sing comfortably. Do not stress your voice! If you find yourself doing an exercise where you have difficulties humming or singing the note you selected, stop the exercise, select "Show exercise options," and remove the note(s) from the selection.

At each level you have two sets of notes: One set for the test, where all competing users have the same difficulty level, and one set for the training mode, where you can get various help options to make your task easier.

When you choose "Training mode" the additional options below that mode are accessible. The points you reach during a session with the training mode are not shown in the overview of the lesson dialog box.

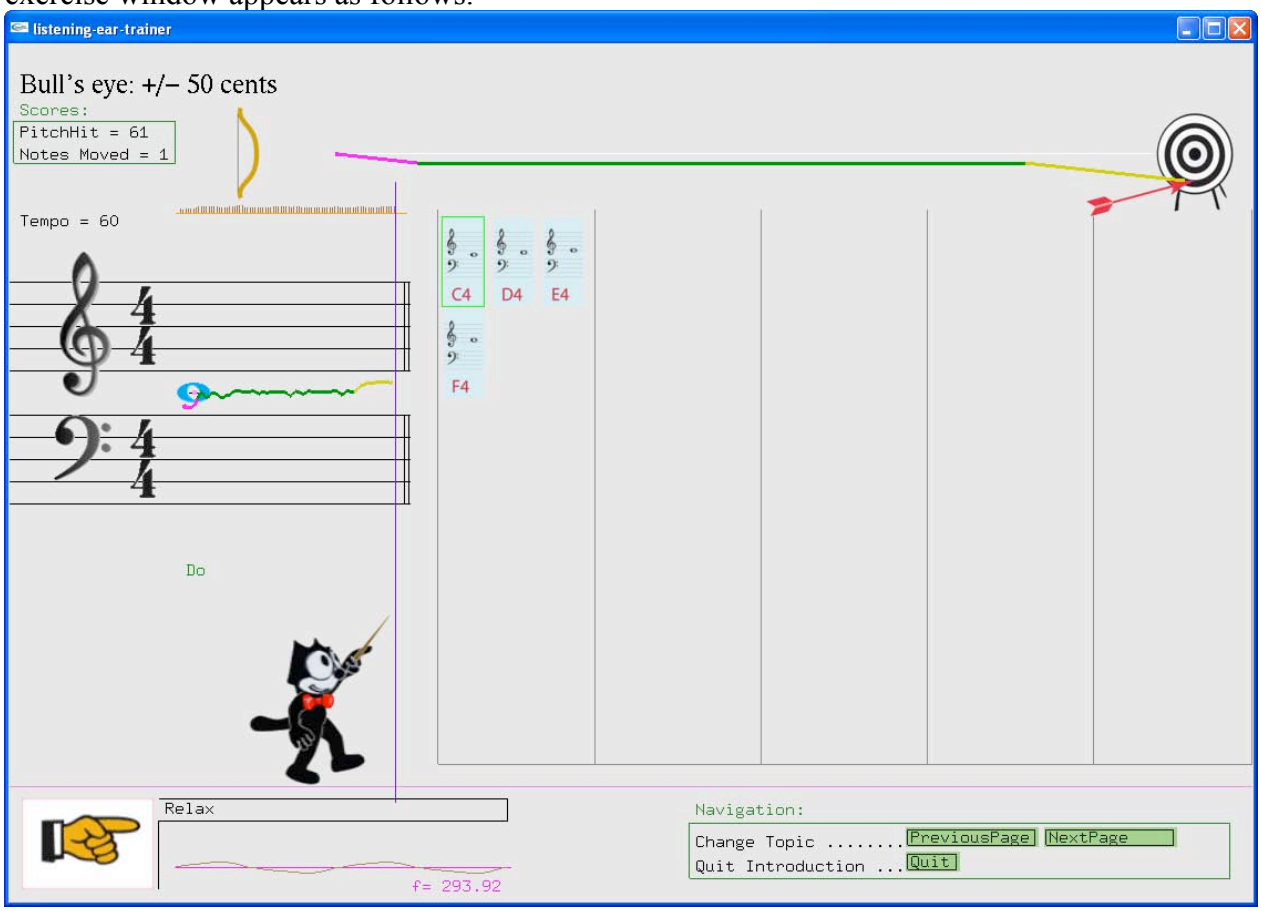
The training mode makes it easy to learn the concepts. The options are as follows:

- Show Pitch Progression:
  Enabling this option will show you – in real time – the pitch you sing. If this option is enabled, the pitch arrow line, which shows the cumulated error, will be displayed from the beginning. In the test mode there is a delay, so you cannot cheat and you must rely on your pitch memory.
- Show scope:
  This option will display the waveform from the input device and also display the detected frequency in Hertz.
- Random Note Every...:
  Normally the first note in the Learning box (In the exercises all chosen cards (pitches you selected for the training) in the bins are laid out and visible) will be presented to sing. However, if "Random Note Every..." is not 0, a random number between 0 and "Random Note Every" will be produced. If the produced random number is 0, then a random card from all the cards will be taken instead of the first card in the queue. Thus, statistically, in every "Random Note Every..." a random card will be displayed. This ensures that notes further down the bins get tested randomly. If you fail to sing the note correctly, the card gets moved back to the first bin.
- Play Note:
  If this drop down menu is not set to mute, then the note on the test bench is played during the count-off. Attention: If you set the instrument to "Sinus," you need a good headset to hear the low notes. Mediocre loudspeakers tend to fail when reproducing frequencies below A2 (110 Hz). The flute sound has more overtones and thus will be easier to hear.
- Accept as correct from:
  For a note to be considered correct, you must hold the pitch within the chosen tolerance for a minimum of "Accept as correct from" samples. Lowering this number allows the user to have more glitches, since the sung answer is accepted as correct with fewer points. The maximum of correct samples you can reach is dependent on the tempo. For a tempo of 60 the maximum is 86.
- No Animation Pause:
  This option allows you to go faster in the singing training. Normally, the note tested gets moved to its new place with animation. This takes some time, which is good since the

next note is more difficult to construct from the previous note if the time period between two notes is longer. This way you can build your answer less on relative pitch. However, to improve your sound production ability, these additional pauses are not necessary, and you can set this option to move more quickly from one note to another.

- Show loudness:
  This option will display the volume level of your singing. The optimum volume is shown when the displayed bars are purple. Orange means the volume is too loud and brown means it is too soft.
- Tempo:
  In decreasing the tempo you must hold the note longer. Increasing the tempo will shorten the time between note presentations. However this option may interfere with the option "Accept correct from," since there is less time available to make enough points.

When done with your selection, click "Go." The exercise will start with the selected options. The exercise window appears as follows:



Here the options "Show Pitch Progression," "Show scope," and "Show loudness" were chosen. In this sample the note C4 was sung or played long enough in the desired tolerance to be accepted as correct (the arrow still hit the target). Thus the note got a green frame and will be moved to the next bin. The notes D4, E4 and F4 in the first bin will also move forward. If not the select "Random Note Every …" , comes in play, then the note D4, - the next in line -, will be tested next.

If you have selected “Training mode” a button labeled “Move Note” allows you to simulate a successful hit. This is useful if you have selected notes with which you have difficulty: you can simply move the note to the next bin. Moving the note from the first bin will allow you to continue working with other notes.

Or, if you have substantial difficulties to sing a particular note, stop the exercise and remove the note from the selection altogether. Do not unnecessarily stress your voice with inconveniently selected notes.

The score continues indefinitely, so even when you have moved all notes to the last bin, you can continue testing yourself. Starting an exercise sets the exercises to do count to 25. But does not reset the score, and the cards stay in the bins where you left them.

Absolute pitch 220 cents

This exercise is the same as the lesson “Absolute pitch 480 cents,” but the tolerance allowed here is only 220 cents. The diminishing cents in the following exercises force you to be more precise than in previous exercises.

Absolute pitch 120 cents

This exercise is also the same as “Absolute pitch 480 cents,” but the tolerance allowed here is only 120 cents.

Absolute pitch 75 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 75 cents.

Absolute pitch 50 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 50 cents.

*50 cents is the minimum requirement to claim absolute pitch.

Absolute pitch 33 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 33 cents.

*A tolerance of 33 cents should be achievable without special voice training.

This tolerance gives you the needed confidence that will show in your performance that the pitch lies in the *center* of a note.

Absolute pitch 25 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is

only 25 cents.

Absolute pitch 20 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 20 cents.

*This is likely the highest level you can reach without special voice training.

Absolute pitch 16 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 16 cents.

Absolute pitch 12 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance allowed here is only 12 cents.

Absolute pitch 7 cents

This exercise is also the same as “Absolute pitch 480 cents;” but the tolerance here allowed is only 7 cents.

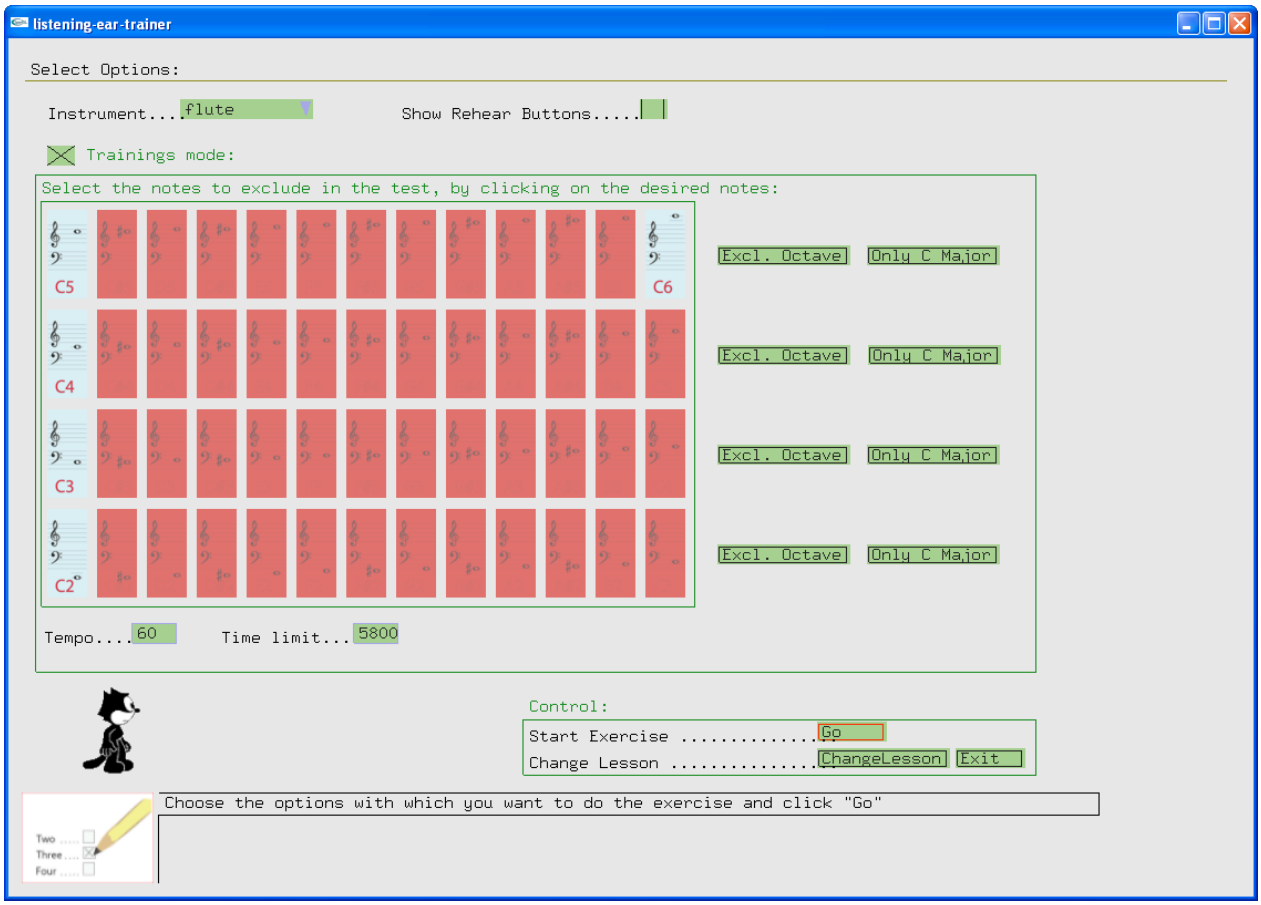
*This last level is very challenging and not really needed. Everybody has some natural vibrato in the voice. To reach 7 cents you have to suppress this natural vibrato, which takes the richness out of your voice.

The Octave Anchor Pitches exercises

The following exercises are listening only exercises. Since the exercises follow a systematic, you should not skip exercises. You are advised to learn the notes thoroughly. Since the method sharpens your listening skills by differentiating new notes from already learnt notes, it is a prerequisite that you know the learnt notes. .

Recognize the Cs

This is the starting exercise for the Octave Anchor Pitches method. As with the "Absolute pitch … cents" exercises, you can select the "Show exercise options" in the lesson dialog box, before starting the lesson.

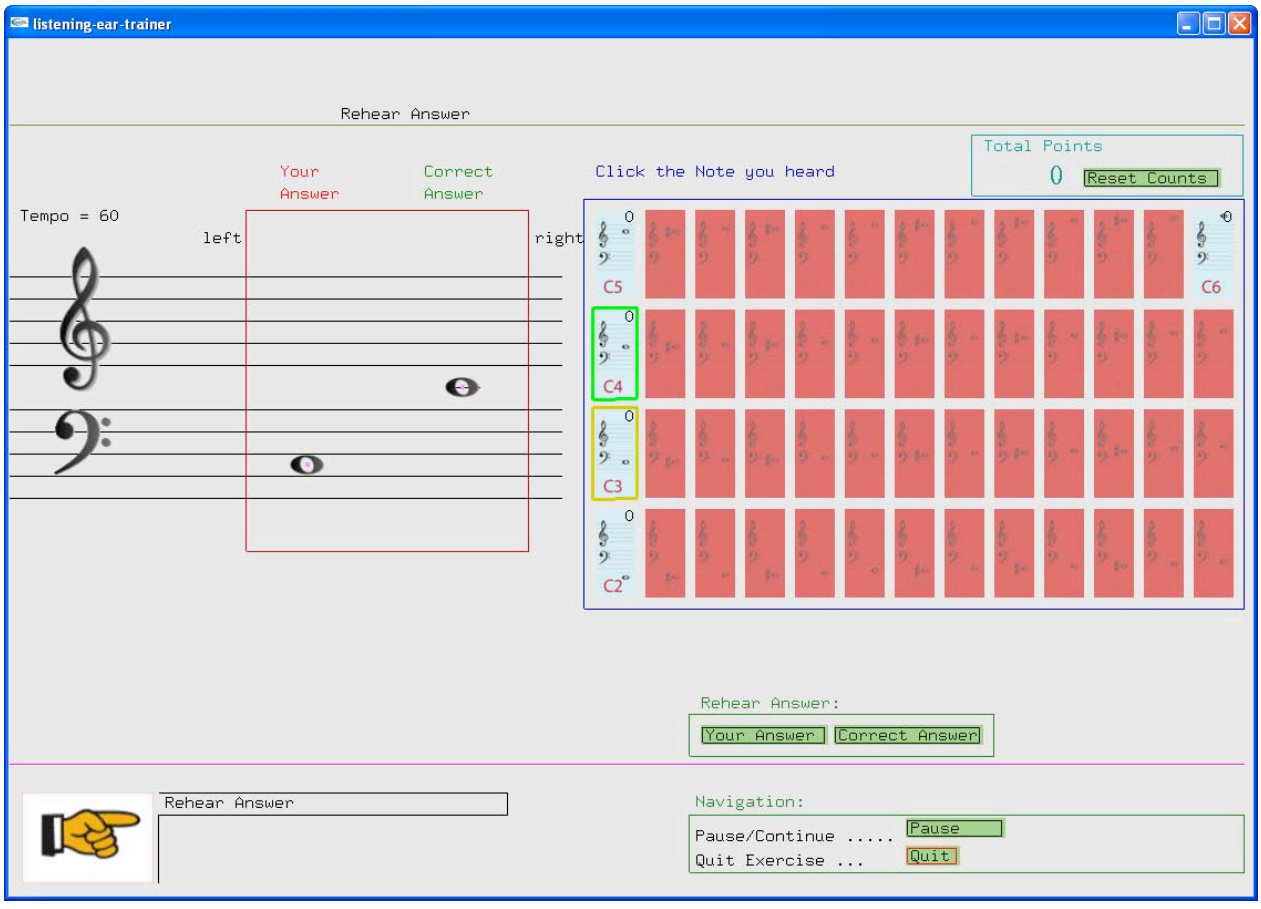


Here the following options are available:

- Instrument:
  Here you can select "flute" or "Sinus." The Sinus sounds are pure and should produce fewer overtones in your headset or speakers. In training mode a male voice can be selected that will sing the solfège syllables. Attention: If you set the instrument to "Sinus" you will need a good headset to hear the low notes. Mediocre loudspeakers tend to fail when reproducing frequencies below A2 (110 Hz). The flute sound has more overtones and thus will be easier to hear.

- Show Rehear Buttons:
  After each test this option will display two buttons that allow you to rehear your answer, or the correct solution. This helps you to better understand your error. If you do not hit one of the two buttons, the test continues with the next note after a second or two.
- Training mode:
  If selected additional training options are available.
- Exclude/include notes:
  In training mode you can exclude a single note by clicking on that note. By clicking on "Exclude Octave," you exclude the whole octave from the test. By pressing "Only C Major," you select only the notes that belong to the C Major scale.
- Tempo:
  The tempo setting allows you to adjust the length you will hear the note in order to detect the pitch. Lower tempo values will increase the length of time the note is sounded and higher values will decrease this length. The shorter the time in which you listen to the sound, the more difficult it becomes to assign a note-name to the pitch.
- Time limit:
  The time limit setting allows you to limit the time in which to identify the note. Shorter times give less time to go through your inner repertoire of sounds. Longer times allow you to compare and reconcile the sound before you have to respond.

When done with option selections, click "Go." The exercise will start with the selected options. The exercise window appears as follows:



The sound or pitch you must detect will be played and question marks displayed on the staff. Your task is to click the corresponding note symbol you hear.

In the above screenshot the note C3 (your answer is logged with a yellow frame) was chosen. The note played was C4 (the correct answer is surrounded by a green frame). In addition, the option "Show Rehear Buttons" was chosen. This allows you to compare your answer again to the correct answer.

Each note symbol has a counter in the upper right corner. This counter shows you how many times you have hit a note in a row without making an error. The counter stops increasing after 7 hits. That means the maximum points you can reach for this exercise is 5 notes (C2, C3, C4, C5 and C6), multiplied by 7 hits, which equals 35.

The score continues indefinitely, so even when you have reached the maximum possible points, you can continue testing yourself. Starting an exercise sets the exercises to do count to 25. But does not reset the score, and the hit count for each note stays where you left it last time.

*You may reset all counts to zero by pressing the button "Reset Counts."

Adding the Gs

This exercise adds G2, G3, G4 and G5. As its perfect fifth, the G is the strongest overtone of the note C, and is already contained in the sound of the C as such. Therefore you should learn to differentiate the characteristics of Gs from the characteristics of Cs. To do this easily, it is strongly recommended that you wait to do this exercise until you have mastered the Cs.

Adding the Fs

This exercise will add F2, F3, F4, and F5. If you invert the interval of C to G, a perfect fifth, you get a perfect fourth, or F. That means the Fs are also present as overtones when you hear a G. To avoid getting confused, you should master the previous lesson before you continue with this lesson.

Adding the Es

The pitch E is part of a C Major triad, Thus you will often hear E together with C and G. You should train yourself to differentiate these notes. A solid recognition technique for the previous notes is necessary in order to hear the distinguishing character of E.

If your brain begins looking for methods to better remember the pitches of notes, do not hesitate to use the Singing Funnel method. If your range does not allow you to sing a note comfortably, sing the note an octave lower or higher. Since the octave is the strongest overtone, there are enough similarities to find the relation between the pitches.

Adding the As

Next we add the As to expand our recognition exercises in the upper part of the C Major scale.

Since by now you can recognize the other lower notes, the As should have enough differentiating characteristics to be recognizable.

Adding the Ds

The Ds fill the lower gap of the C Major scale.

Adding the Bs

The Bs completes our C Major scale.

Recognize the Note

The Recognize the Note exercise enables all notes so that notes outside the C Major scale can be learned. We recommend that you use the training mode to exclude some notes and slowly add the remaining notes to your repertoire. Use the C Major anchor points you've learned to classify the added notes. This way you can recognize the note C-sharp, for example, as between C and D.

Introductory Lessons: Relative Pitch

Introductory lessons are the only animated lessons of the method. They explain the concept of relative pitch and how our program helps you to improve your interval recognition.

Introduction: Relative Pitch

This lesson gives a short overview of the definition of relative pitch, and introduces you to the most basic relative concept in music: the intervals.

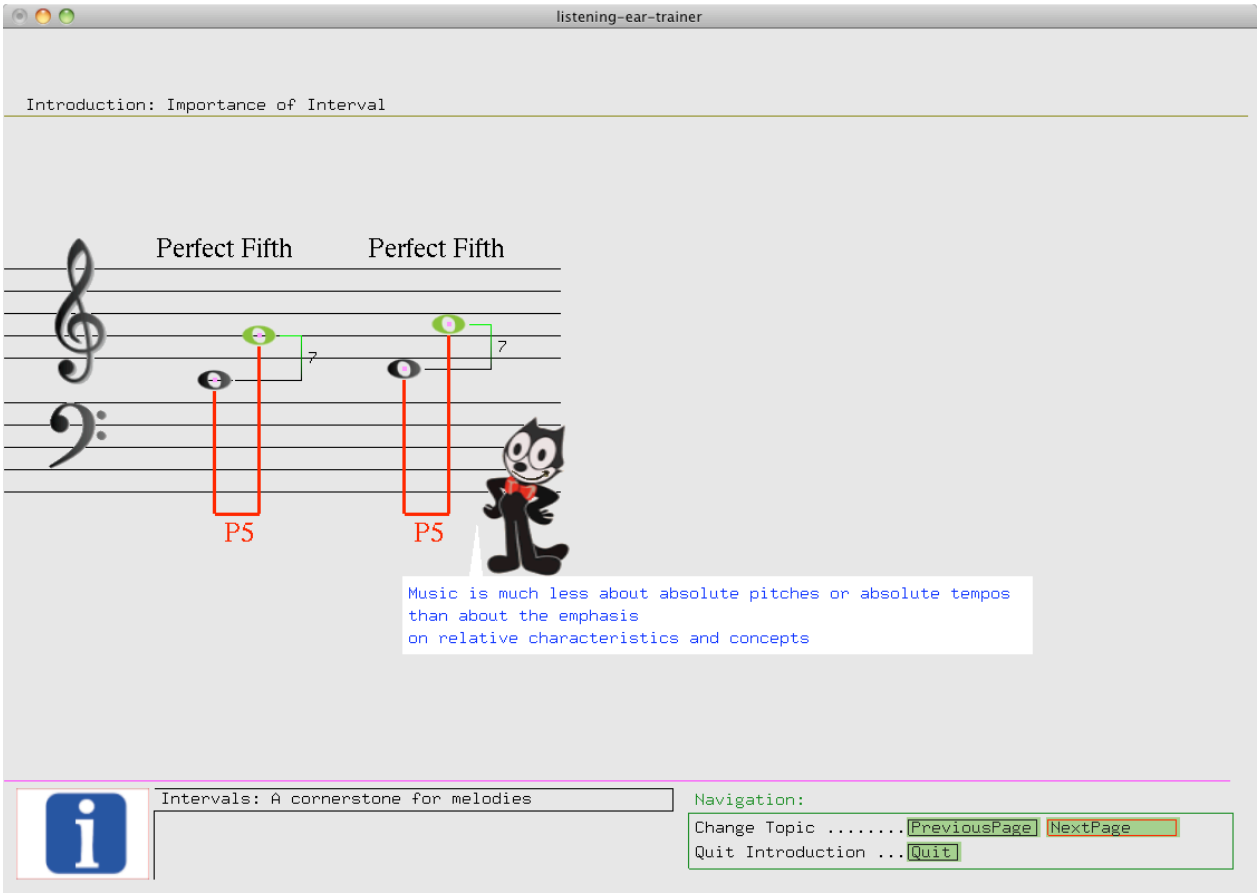
What is relative pitch?

When you listen to a melody, you follow its changes, both in rhythm and pitch. A change can be described as an absolute event or as one relative to the previous state.

Since the starting pitch is only relevant in relation to subsequent pitches, in carrying a melody change is expressed in terms of relative changes, in order to better describe a melody. As long as the relative changes stay the same, a melody can easily be recognized as a particular song, regardless of its starting pitch (see the "Silent Night" example under "Learn to recognize Intervals by identifying similarities" in the *Welcome* section of this manual).

For pitch changes, musicians use interval names to describe the change. For example, a melody might go up a Major third, or down a perfect fifth, or may repeat the same note.

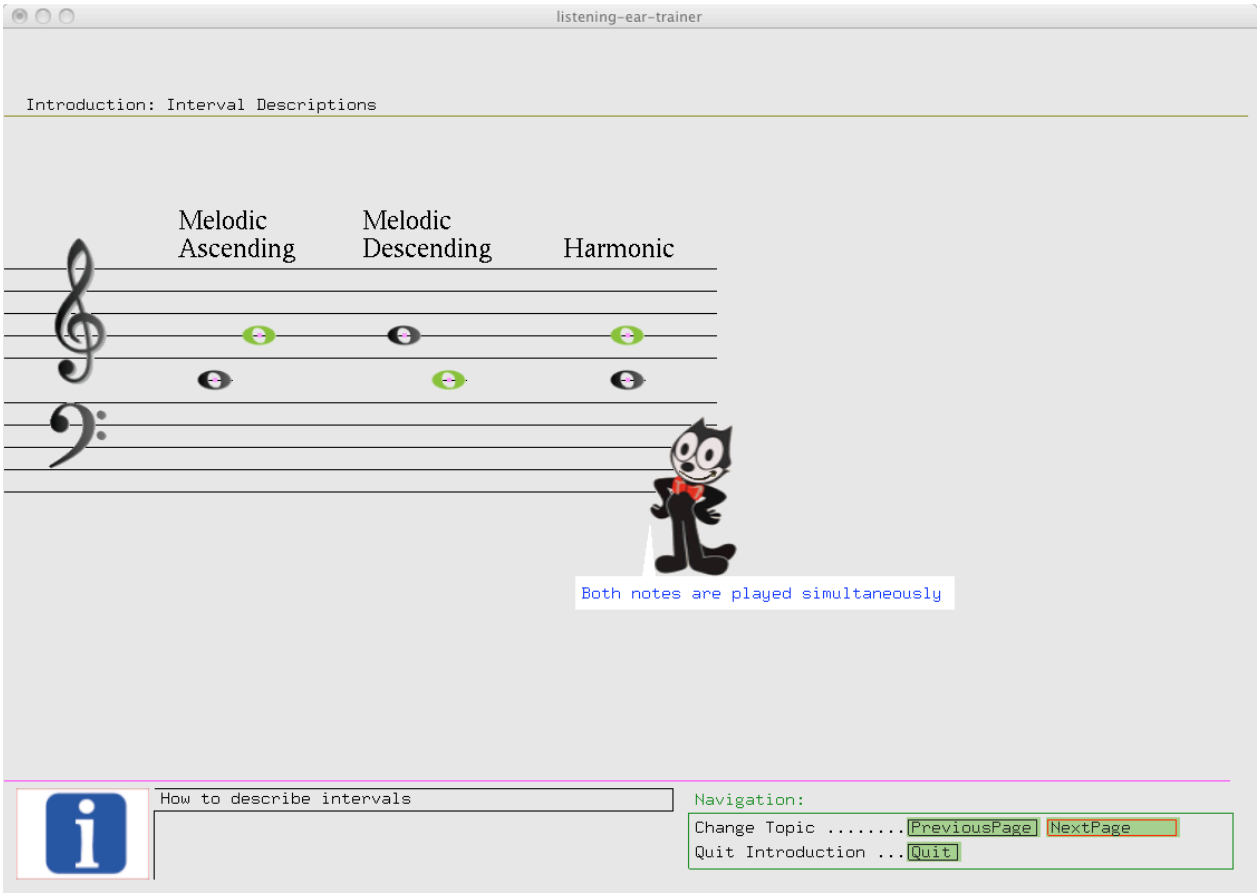
The distance between two notes can be given as an interval name or as the number of semitones they encompass. The number of semitones (or half-steps) is more universal, but is not conventionally expressed in musical context.



In the dialog box above, both depicted note-pairs have perfect-fifth intervals. The second interval starts a whole tone higher than the first.

Intervals are basic building blocks for melodic movement.

Intervals come in three flavors



Intervals describe the relationship between two notes. In a chord with more than two notes, each possible pair of notes can be described with an interval name.

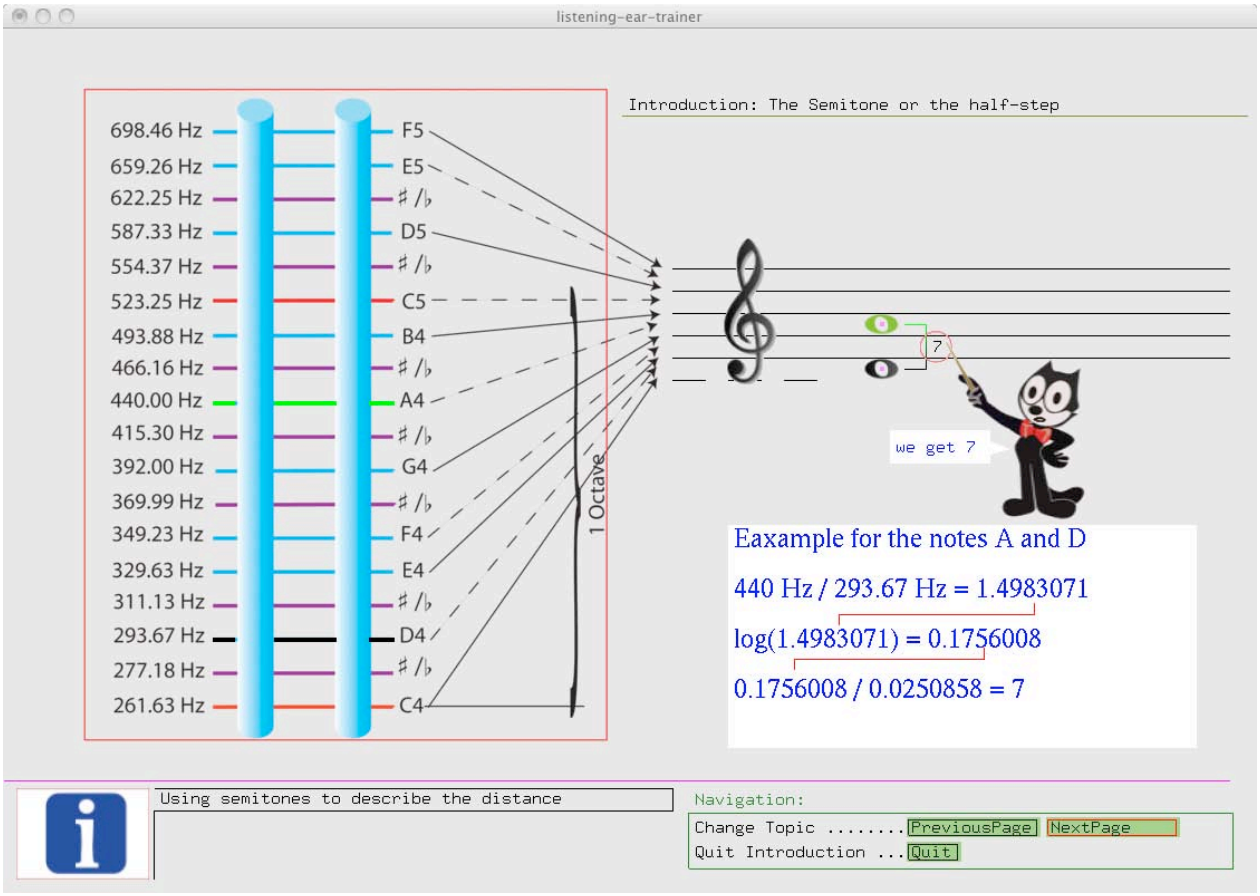
Melodic intervals: When the pitches are played in succession, or one after the other, then the interval can be described either as ascending or descending melodically.

Harmonic intervals: When the pitches are played at the same time, or together.

Frequencies and semitones

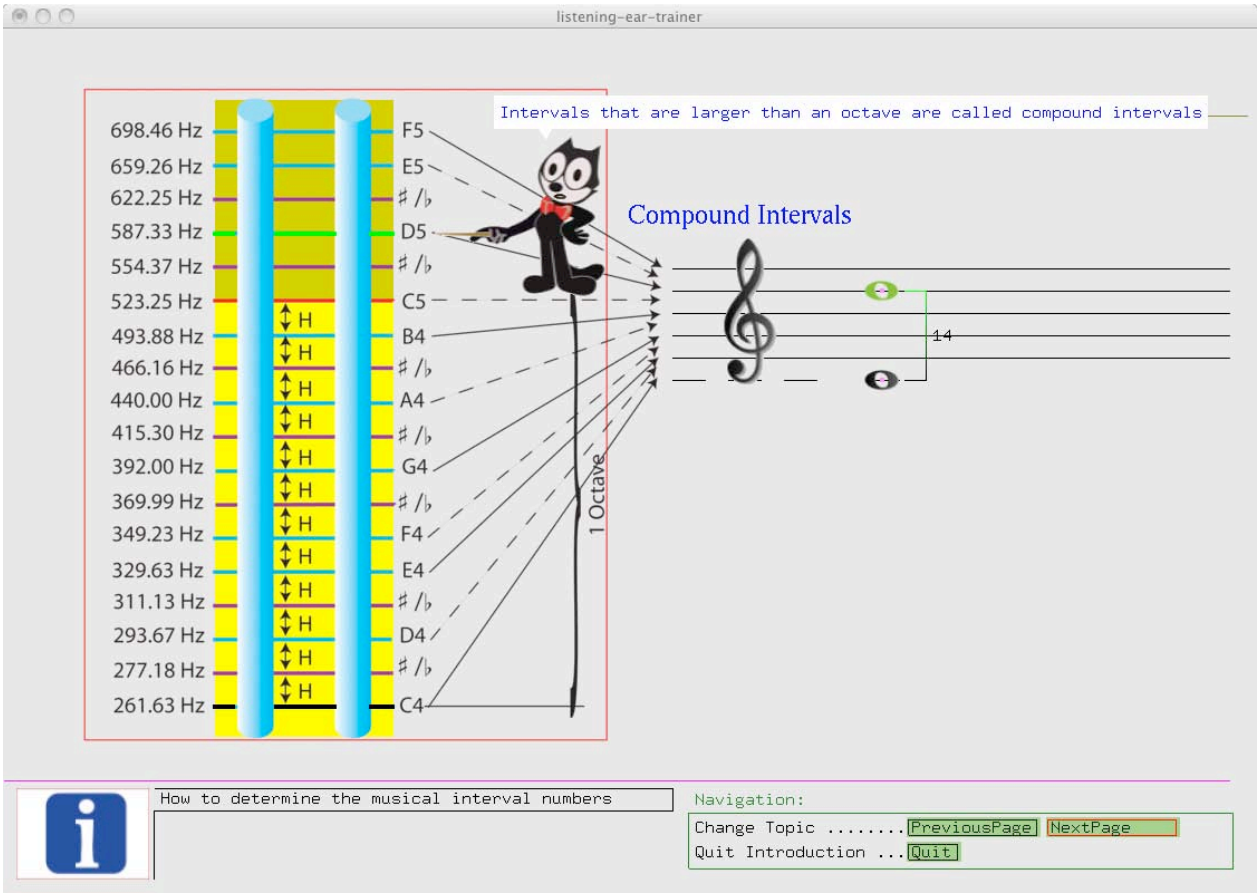
Intervals can also be expressed as the distance between two pitches in semitones. A semitone is the smallest unit used in twelve-tone, equal-temperament music notation.

Since a semitone from the low C1 to the low C1-sharp is the same as a semitone from C6 to C6-sharp, the frequency of the involved pitches is meaningless. For the technically interested we show how you can calculate the number of semitones from the frequencies of the notes.


listening-ear-trainer
698.46 Hz
659.26 Hz
622.25 Hz
587.33 Hz
554.37 Hz
523.25 Hz
493.88 Hz
466.16 Hz
440.00 Hz
415.30 Hz
392.00 Hz
369.99 Hz
349.23 Hz
329.63 Hz
311.13 Hz
293.67 Hz
277.18 Hz
261.63 Hz
F5
E5
♯ /♭
D5
♯ /♭
C5
B4
♯ /♭
A4
♯ /♭
G4
♯ /♭
F4
E4
♯ /♭
D4
♯ /♭
C4
1 Octave
Introduction: The Semitone or the half-step
7
we get 7
Eaxample for the notes A and D
440 Hz / 293.67 Hz = 1.4983071
log(1.4983071) = 0.1756008
0.1756008 / 0.0250858 = 7
Using semitones to describe the distance
Navigation:
Change Topic ....PreviousPage NextPage
Quit Introduction ...Quit

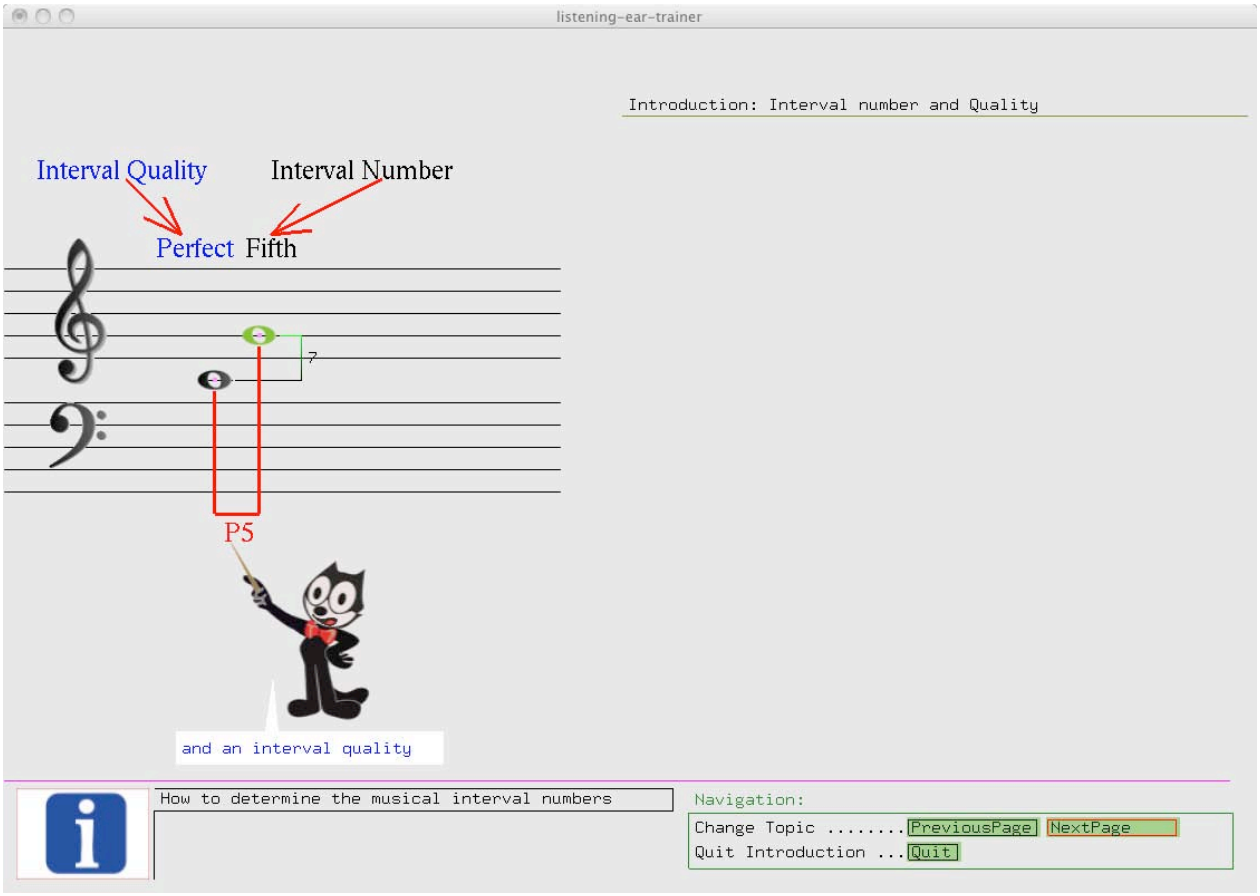
Interval names

Since a pitch played an octave higher has such a strong relationship to its root pitch, octaves are sometimes neglected in musical discussions.

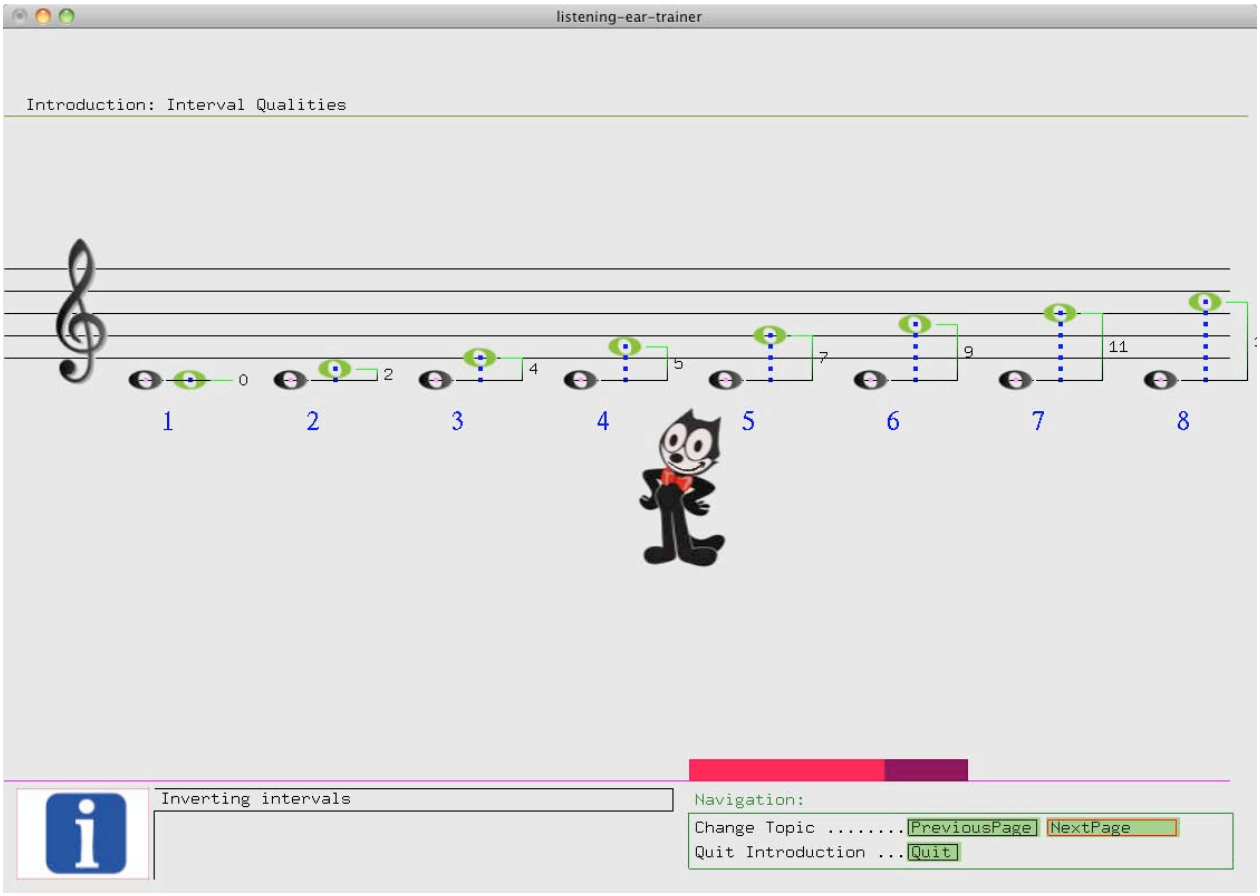


For that reason, musicians distinguish between “Simple Intervals,” or intervals smaller than or equal to an octave (the yellow area in the above picture from C4 to C5); and intervals larger than an octave (going from C4 into the dark yellow area above C5). These larger intervals are called “Compound Intervals” and relate to simple intervals. The naming of compound intervals can be calculated by counting the number of octaves and the simple interval (or by using normal rules of music theory, which we will explain later). For example, an interval spanning an octave and a Major third is called a Major tenth, or compound Major third. Applying the standard rule to determine intervals yields a Major tenth. For now we will concentrate on simple intervals. You will have a chance to learn compound intervals during the exercises.

An interval name consists of a number and a quality.

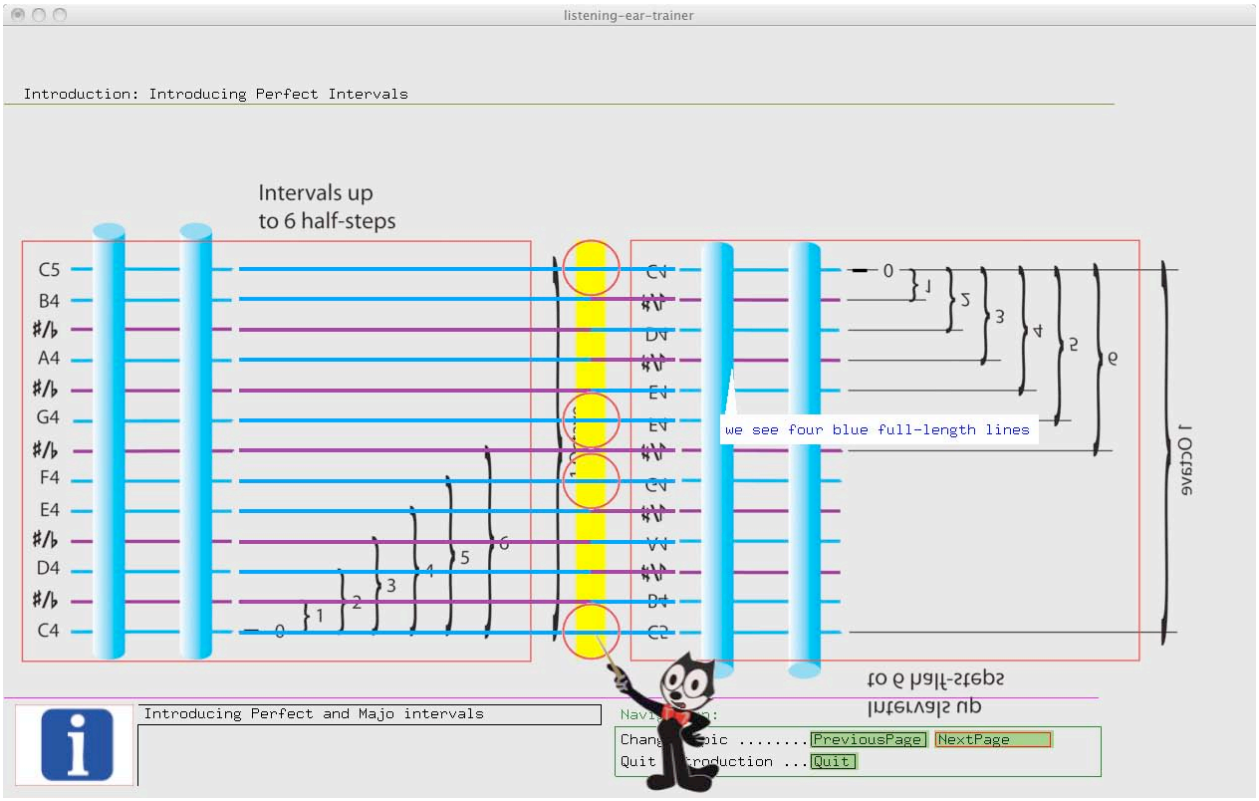


The interval number is the number of steps (half and whole) between the two scale notes, or degrees. For the C Major scale we get the following picture for the interval numbers:



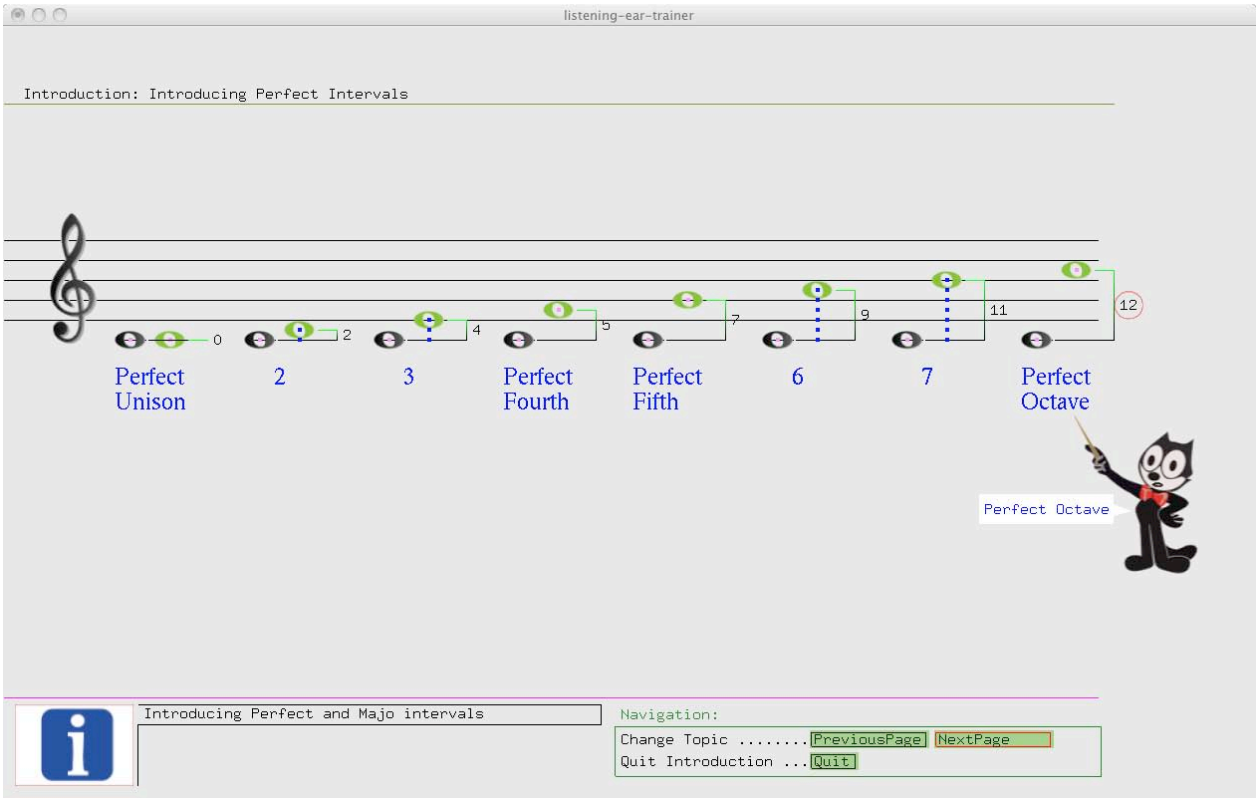
The vertical blue dots in the picture represent the position of a note in the scale. By counting these blue dots we get the interval number depicted below the note pair.

The quality of an interval also expresses a relationship with its inverted interval. To illustrate this, let us look at just the first 6 intervals and their inverted intervals.

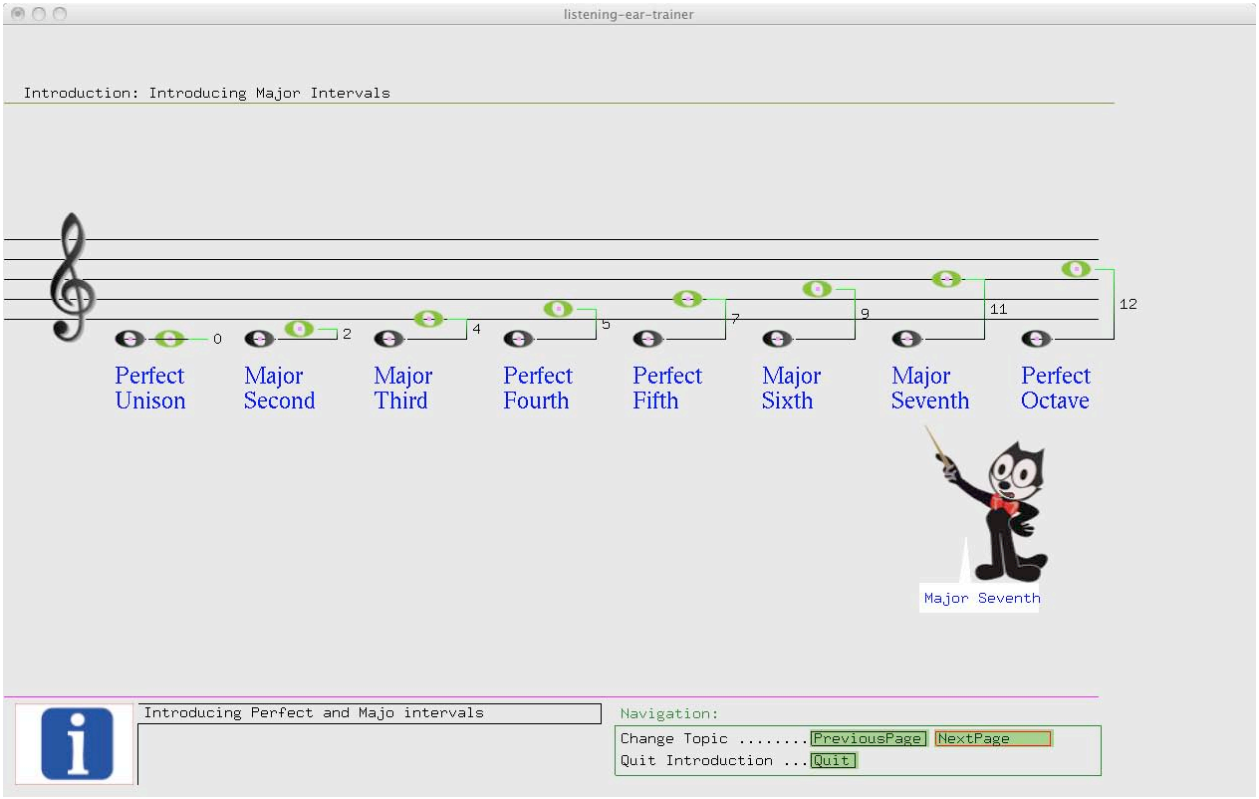


In the above picture the notes or steps of the scale belonging to C Major appear on a blue line while those not in the scale are represented by a purple line. If we compare these blue-colored steps with the colors of the upturned (or inverted) ladder, we see four full-length blue lines (i.e. unlike those that begin as a blue line but continue in purple at the dividing yellow area in the center). These full-length blue lines denote four intervals that, when inverted, remain within an octave of a C Major scale. When inverted, intervals that stay within the octave of a scale are said to have a perfect quality.

So, our interval number and quality naming now looks like this:

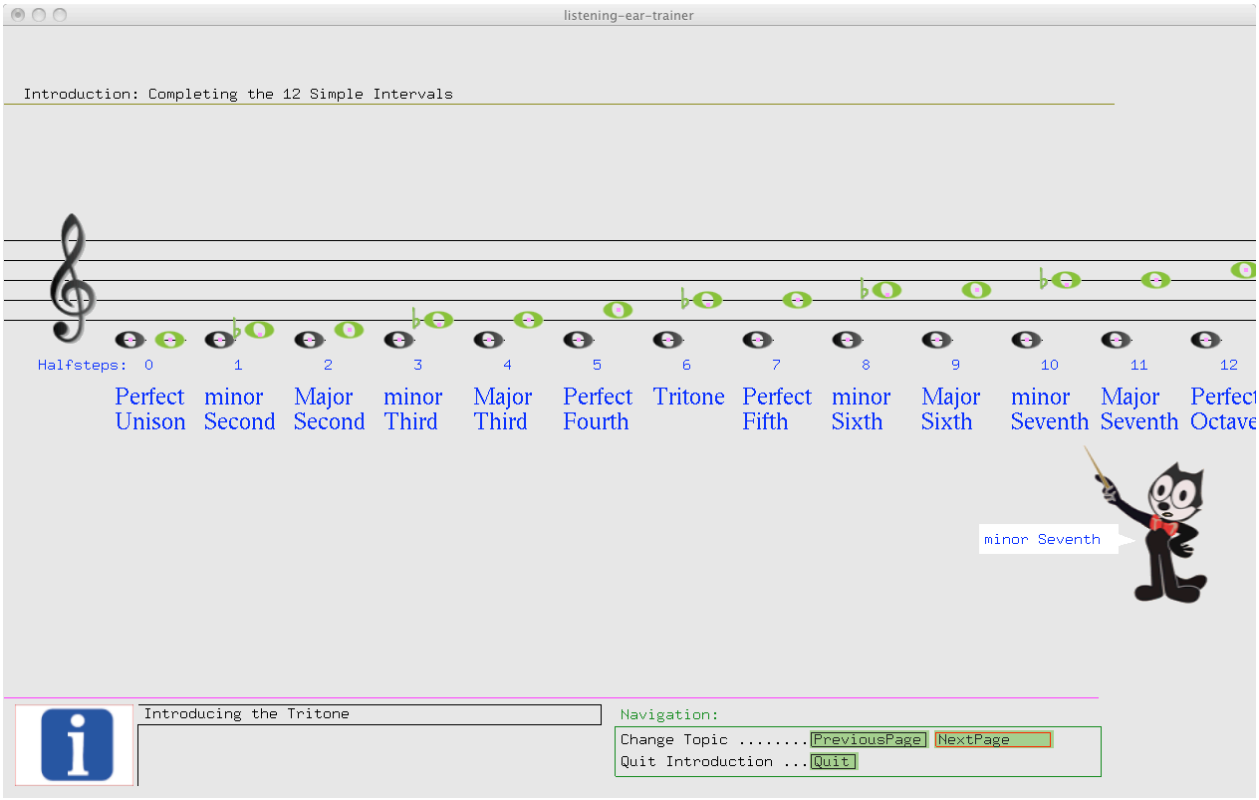


The remaining intervals in the C Major scale have a Major quality, since they make up the Major scale.



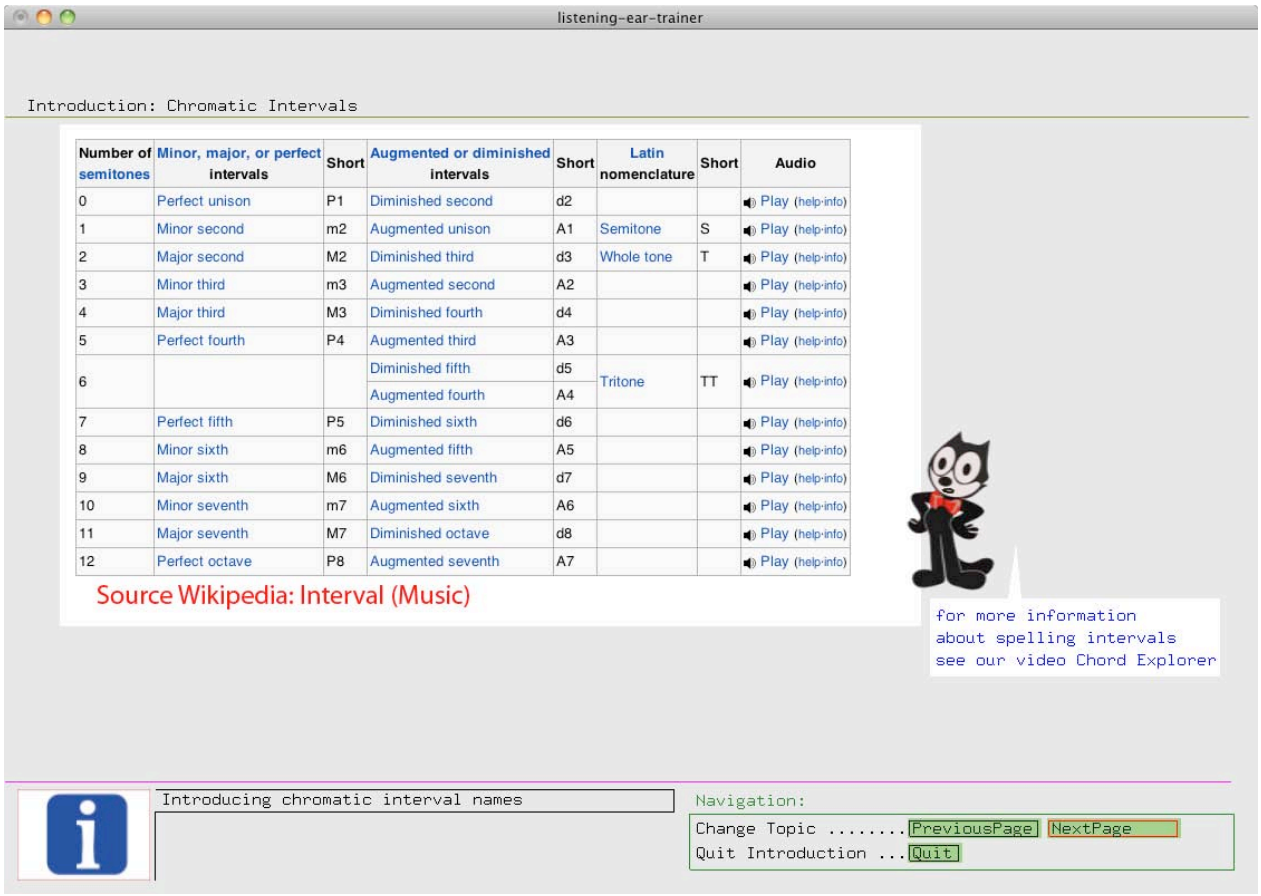
In the above picture we can see that interval names are given only for intervals with a distance of 0, 2, 4, 5, 7, 9, 11 and 12 semitones. The interval qualities are obtained for the remaining five intervals, with a distance of 1, 3, 6, 8 and 10 semitones, by lowering the upper note of their sibling Major interval by a half-step, or by adding a flat. With the exception of the tritone interval, which has 6 semitones, these intervals obtain a minor quality.

The note 6 half-steps away from C lies in the middle and continues in purple as a full-length line in the color comparison picture (showing the inverted intervals). Since the note is not part of the C Major scale, this interval is not called perfect, or major or minor. In early music history this interval was called the “Devil’s chord” because of its dissonant sound. Since six semitones are three whole tones the interval name was abbreviated to TriTone.



Alternative interval names

Intervals can also be named chromatically.

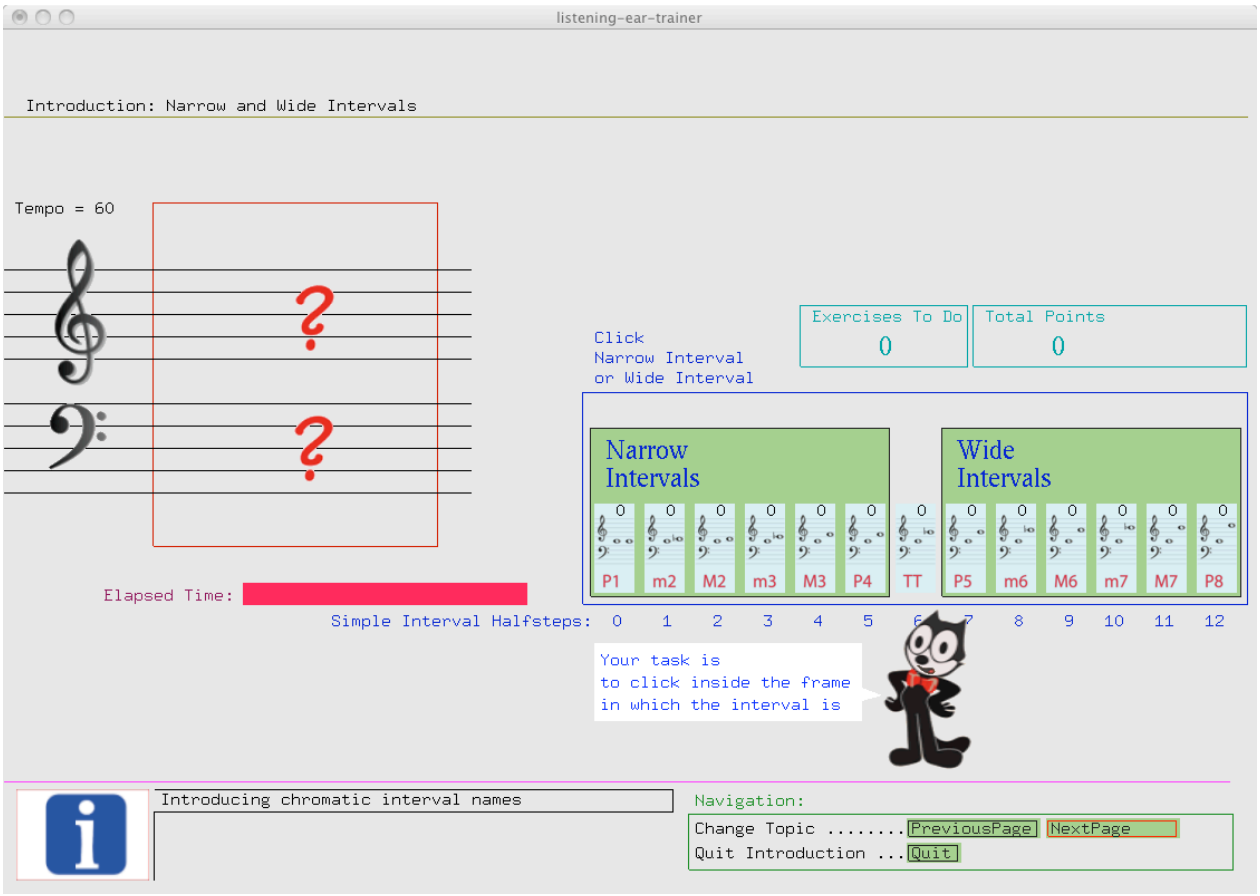


Number of semitones	Minor, major, or perfect intervals	Short	Augmented or diminished intervals	Short	Latin nomenclature	Short	Audio
0	Perfect unison	P1	Diminished second	d2			Play (help·info)
1	Minor second	m2	Augmented unison	A1	Semitone	S	Play (help·info)
2	Major second	M2	Diminished third	d3	Whole tone	T	Play (help·info)
3	Minor third	m3	Augmented second	A2			Play (help·info)
4	Major third	M3	Diminished fourth	d4			Play (help·info)
5	Perfect fourth	P4	Augmented third	A3			Play (help·info)
6			Diminished fifth	d5	Tritone	TT	Play (help·info)
			Augmented fourth	A4			
7	Perfect fifth	P5	Diminished sixth	d6			Play (help·info)
8	Minor sixth	m6	Augmented fifth	A5			Play (help·info)
9	Major sixth	M6	Diminished seventh	d7			Play (help·info)
10	Minor seventh	m7	Augmented sixth	A6			Play (help·info)
11	Major seventh	M7	Diminished octave	d8			Play (help·info)
12	Perfect octave	P8	Augmented seventh	A7			Play (help·info)

In the above table the names for chromatic intervals are shown in the column “augmented or diminished intervals.”

Narrow and Wide Intervals

We start interval recognition by differentiating between narrow and wide intervals.



In this exercise you must ascertain whether the heard melodic interval is narrow or wide. Since in this exercise the lower note is always a C4, chances are that you will solve the task by listening only for the second note. This approach is okay, for those who have absolute pitch.

You should try to grasp the characteristic of the interval by keeping the first note in your mind and listen mentally to find the relationship between the two notes. Your goal should be to draw out the relationship, or change, between the first and second note. The brain helps us with this task as it likes to store changes, not absolute events. By noting changes you build patterns that can be arranged in new ways. This gives you the freedom to explore and experiment. With absolute events nothing can be changed, which is why relative change is more important than absolute events. (Of course absolute events give us stability, starting points, and references. In this way using absolute pitch is still justified.)

We encourage you to improve in both areas: Absolute pitch and relative pitch.

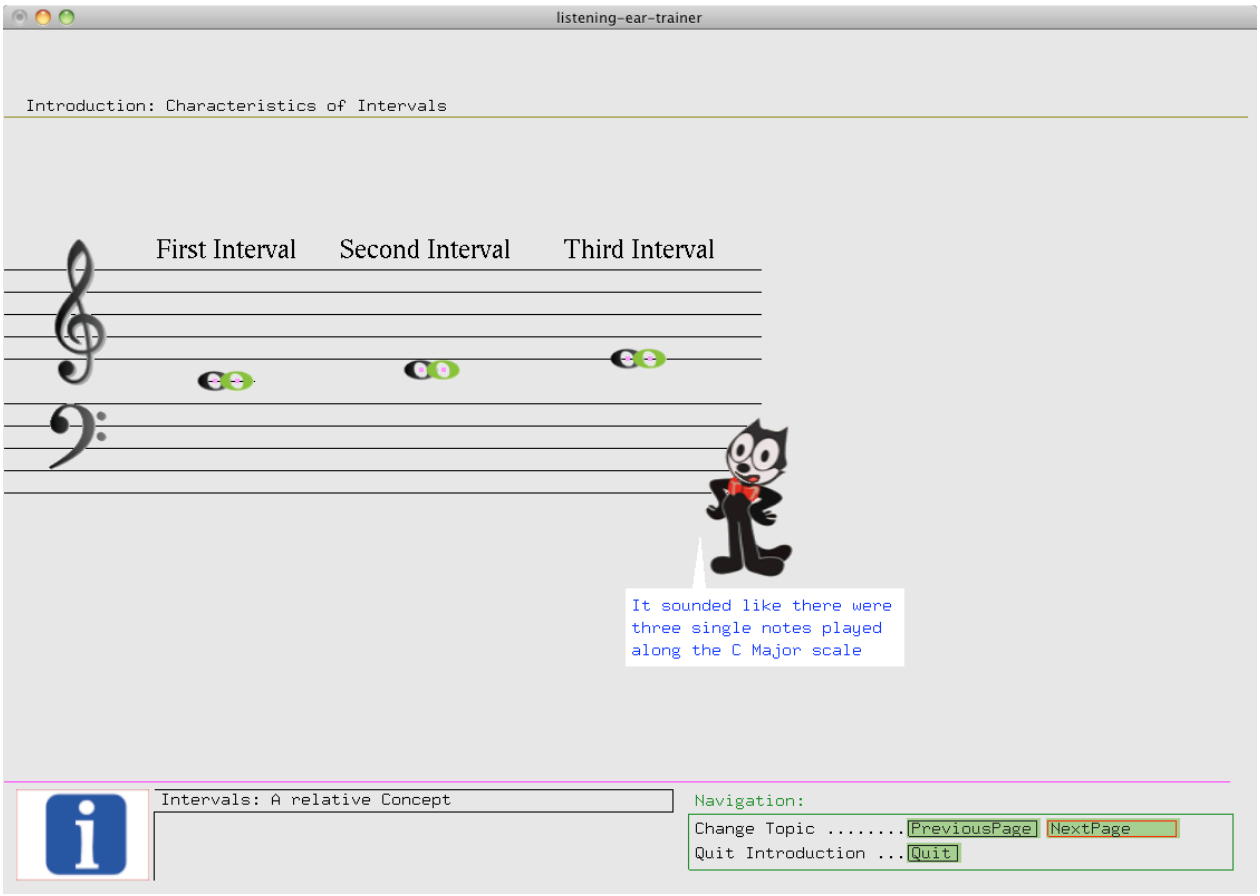
In the next section we explain how our “Interval Overtone Method” works for learning to recognize intervals.

Instructions: Relative Pitch

This lesson shows you how the interval exercises work.

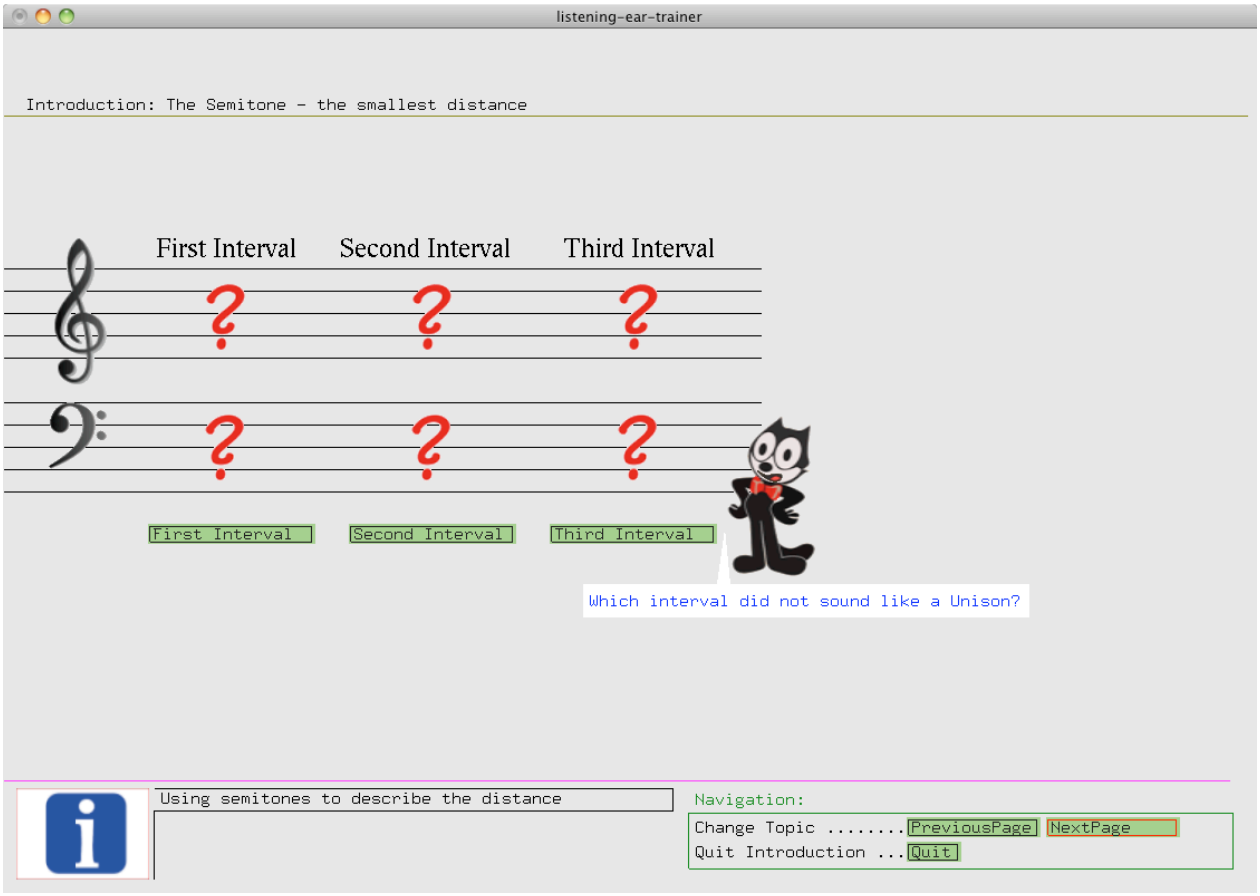
What is an interval characteristic?

When you listen to three harmonically played unison from identical instruments, then if the unisons follow the C Major scale, then it sounds like the first three tones of the C Major scale were played.

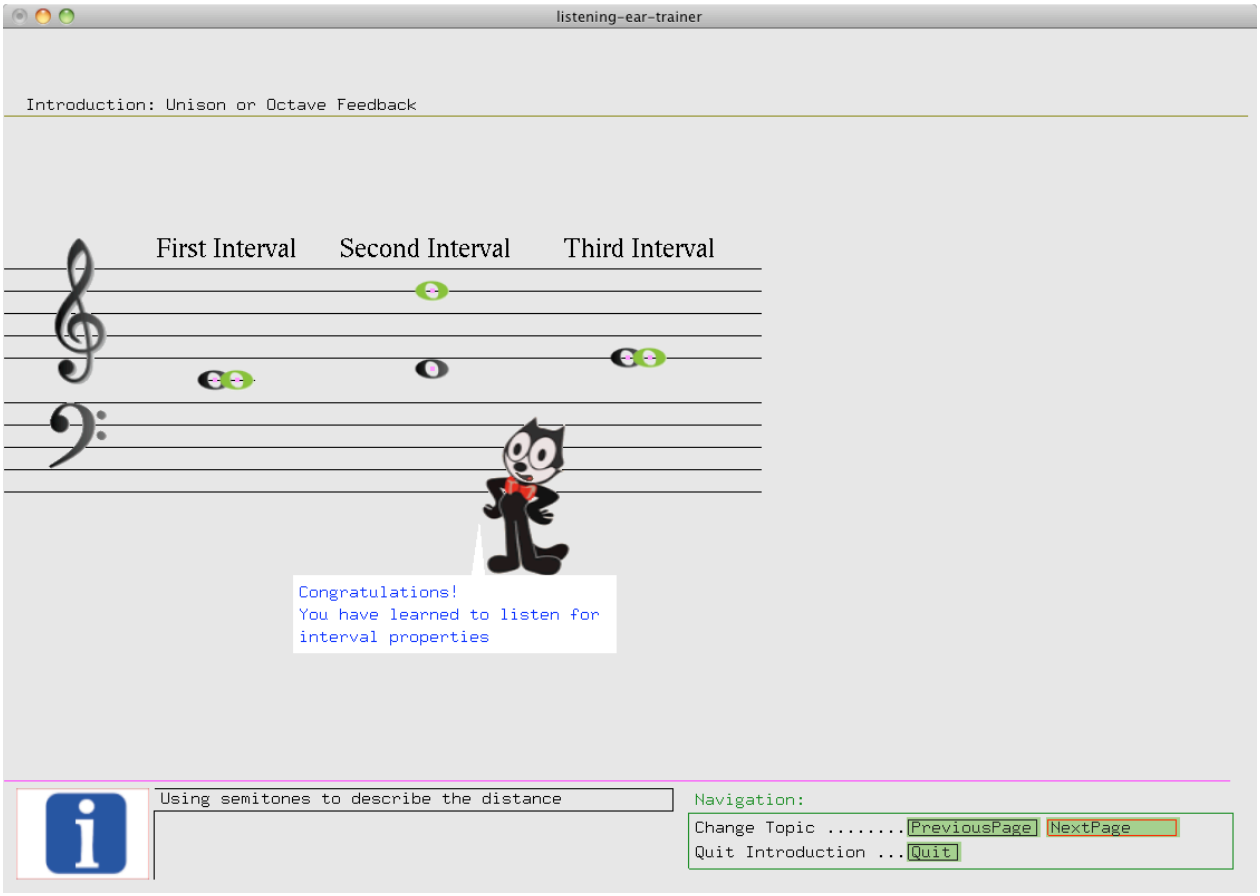


Since, indeed harmonically played unisons from identical instruments are difficult to differentiate from single notes, it is difficult to point out an interval property.

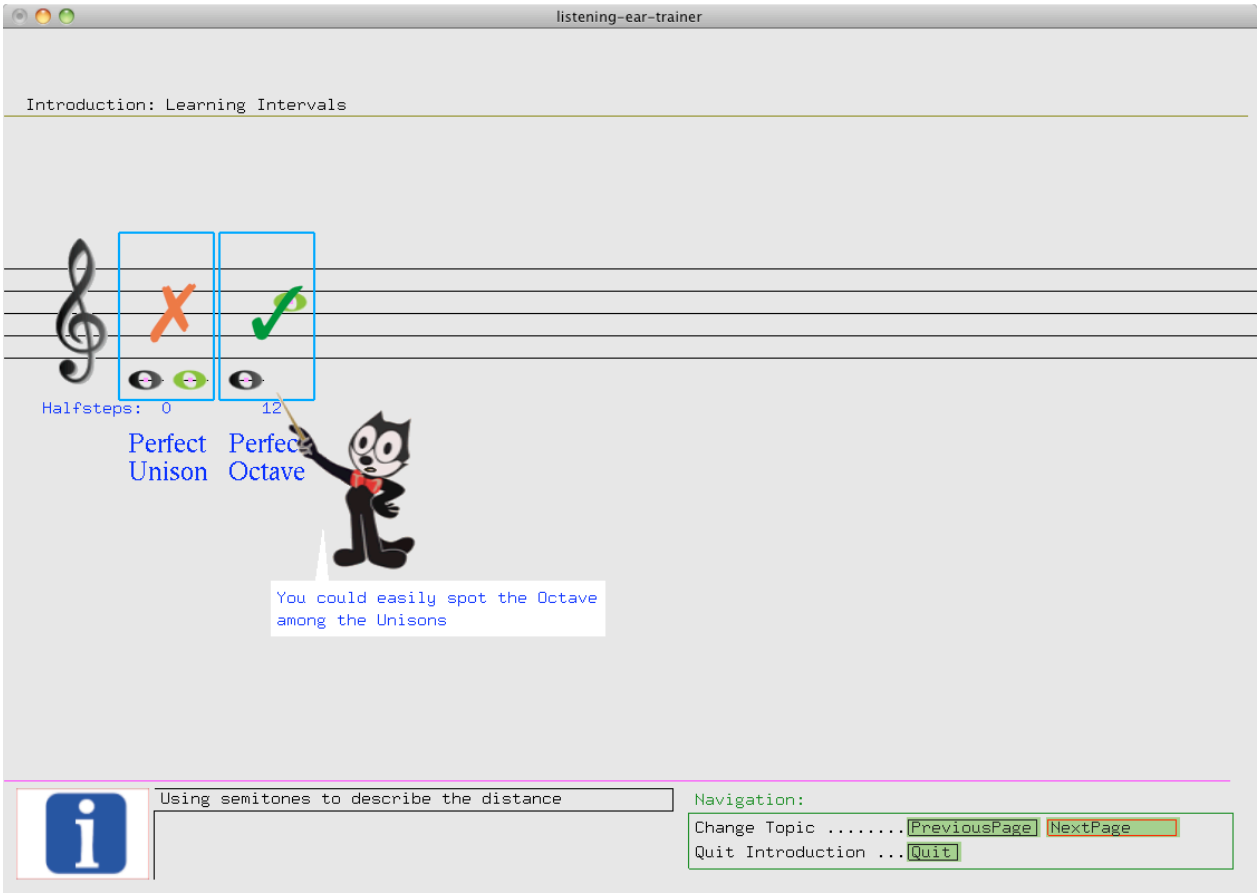
To explain the interval property we therefore play three intervals. Two of them are Unisons and one is a Perfect Octave. It should be fairly easy to find the Perfect Octave among the Unisons.



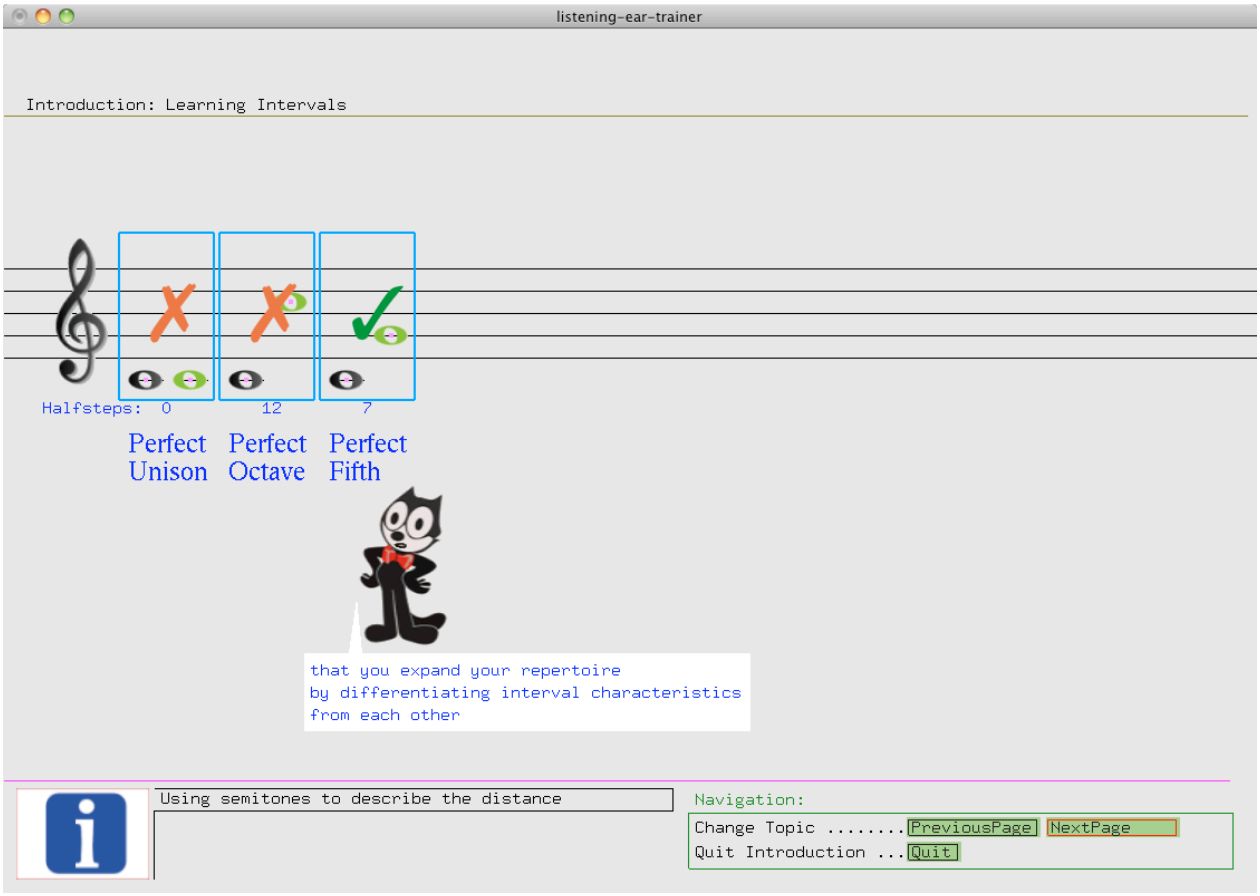
If you can find the Perfect Octave, then you have learned to listen for interval characteristics.



In the first demo of the Unisons, you learned in fact the property of the Unison: It sounds like one sound. You then can identify the Perfect Octave by excluding the Unisons.



You will learn to differentiate the other interval properties the same way: one by one. You will exclude already learned interval characteristics. Thereby you will explore and learn to differentiate the interval characteristics. Finally you will hear the “absolute” interval property of the learned intervals.



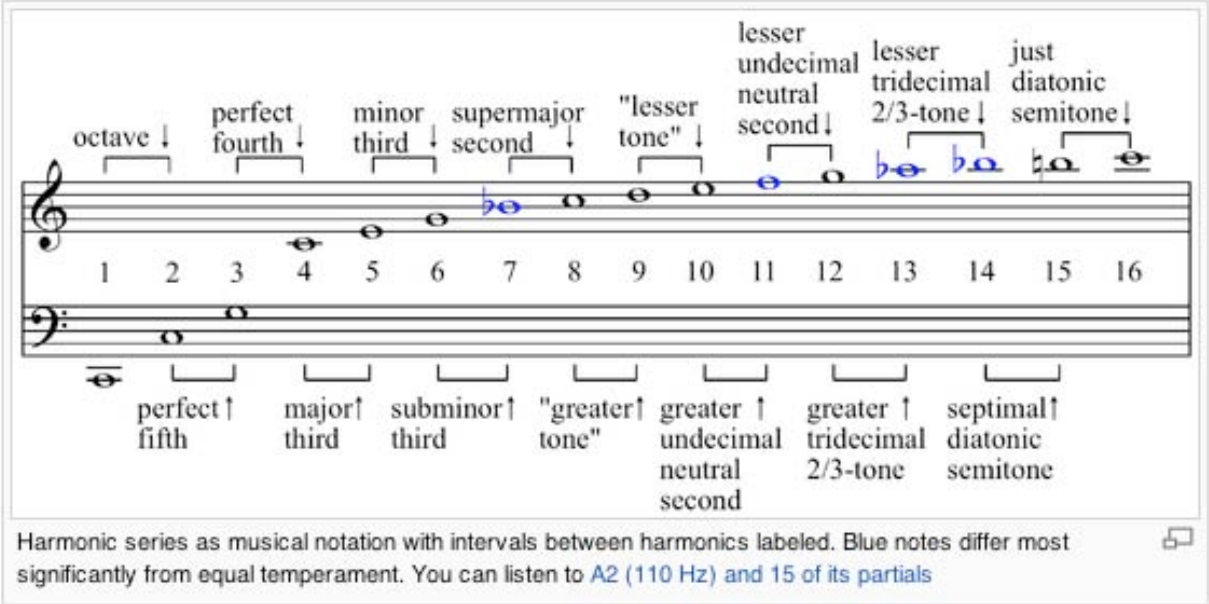
Even so the curriculum follows a strict pattern, you do not have to abandon other learning techniques. Your brain is very flexible and adapts to the learning environment. As soon as you start our exercises, the brain will establish the context to this environment. If not, you will be set back to a level that you still have mastery of. You very fast will catch up again. And since you can follow the progress you make with our method, the motivation to continue and improve should hopefully remain in place.

Theoretical Background

Learning to listen is different than learning to sing, so each needs its own approach. One goal of singing is to learn to control the voice, which is easier to do in small steps. To change the vocal sound just a little, you have to change the tension in your muscles only a little. Because such movements are subtle, not much effort is needed to make a desired change. This is one reason warm-up exercises often start with small steps, staying in a limited range before they graduate to larger leaps.

When it comes to listening, however, the main goal is to learn to differentiate between sounds. Here the following rule applies: the larger, purer, or more simply discerned the difference, the easier the relationship between sounds is to recognize. For interval recognition, our strategy, therefore, is to learn to differentiate with as few distractions as possible.

Every sound has a series of overtones. These overtones make the sound richer and to a certain degree easier to remember, since more impressions—more colors in the sound, let's say—are associated with it. However, to be able to recognize intervals, one must look for similarities *between* two pitches. Thus we must pull from the sounds of two pitches the basic relationship occurring between them. Since every sound has overtones, every sound already has relationships to these overtones within itself. In music, relationships found in overtones are often called harmonics.

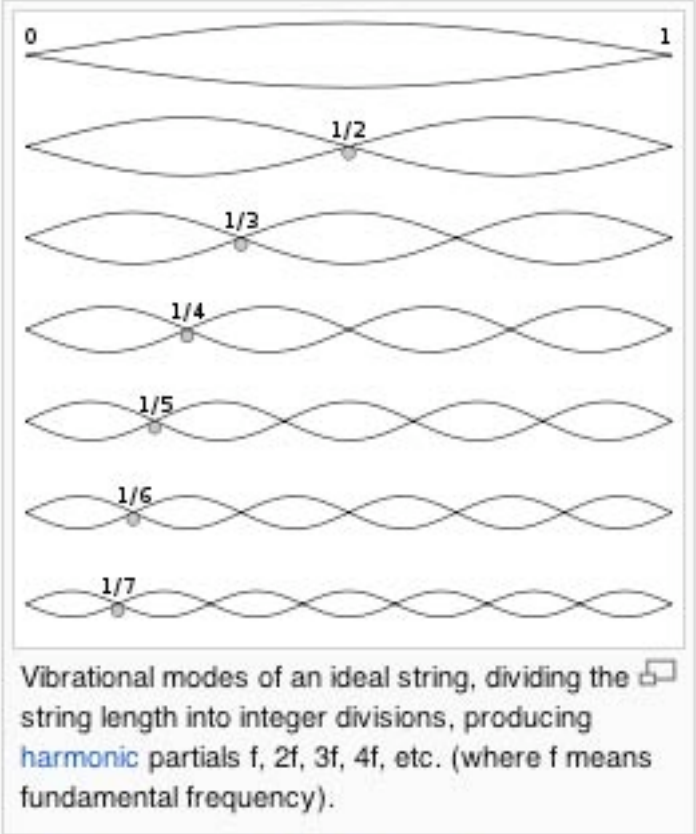

octave
perfect fourth
minor third
supermajor second
"lesser tone"
lesser undecimal neutral second
lesser tridecimal 2/3-tone
just diatonic semitone
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
perfect fifth
major third
subminor third
"greater tone"
greater undecimal neutral second
greater tridecimal 2/3-tone
septimal diatonic semitone
Harmonic series as musical notation with intervals between harmonics labeled. Blue notes differ most significantly from equal temperament. You can listen to A2 (110 Hz) and 15 of its partials

Source Wikipedia: Harmonic series (music)

Now, some review points on overtones:

- Every fundamental (note) has the same relative overtones.
- The harmonic series is derived from integer divisions.

The first point is important, because it emphasizes the similarities between intervals. For example, the second overtone of any pitch is always a Perfect Octave away, and the third overtone is always a Perfect Fifth away.



Vibrational modes of an ideal string, dividing the string length into integer divisions, producing harmonic partials f, 2f, 3f, 4f, etc. (where f means fundamental frequency).

Source Wikipedia

The second point shows the order, and therefore the magnitude, of the overtones. Larger integer values will produce more complex waveforms and thus the likelihood that they emerge is smaller. Therefore they are much less powerful. For example, the third harmonic with 3 bellies is more complex than the second harmonic with only two bellies. Therefore, the overtone sound of the Perfect Octave (second harmonic) is much stronger than the overtone sound of the Perfect Fifth (third harmonic).

Our Interval Overtone Method follows the overtone series, and by practicing with it you can learn intervals with the least distraction from previous learned intervals.

Note: for the explanation of the overtones we will give examples in the C Major scale; however, the learning process is independent of musical context, i.e. the task is to recognize intervals independent of their musical context. In encouraging you to learn to listen for the particular characteristic of an interval, and to avoid relying on a context, our method is a more “absolute” idea of the relative interval recognition process. So instead of learning absolute pitches and then simply deducing their intervallic relationship, you listen for an absolute characteristic of the interval itself. In a functional ear-training program you would learn to recognize intervals in musical context; for example, the intervals in the C Major scale. Usually a cadence is played to give the context of the tonic pitch, or where the music returns to a key center and resolves as an ending. In this context a third from C to E is not considered the same as a third from G to B, since

the first third has a tendency to resolve to the lower tonic pitch (C) and the second third has a tendency to resolve to the upper octave C. Depending on your musical background and fluency in different scales, you may prefer the functional approach. Our approach is straightforward: in the exercises you hear only the relationship between two sounds, without respect to a central pitch, or tonic relationship. In the equal temperament system the physical relationship—as explained in the introductory lesson—stays exactly the same for all intervals of the same distance. Thus there are only 12—as in 12 semitones in the scale—characteristics you must learn. In a contextual environment of tonicization there are many more intervals to learn, because of the many possible such contexts.

Our method tries to go directly to the goal of identifying intervals, by learning the abstract characteristic of each. However in the context of a key center, a Major third played from C to E will not sound the same as a Major third played from G to B, as we have heard these thirds almost always in such musical contexts. And therefore, it is likely that in the beginning difficulties to extract the specific interval characteristic (the frequency ratio) from the sound will appear. In addition, our ear is not linear; it hears pitches in the middle range better than those on the edges of the sound spectrum. This also makes it a little more difficult to discern specific interval characteristics. Since, by definition the concept of intervals spans all keys, starting on any note in the spectrum, we think it best not to rely on a specific musical or key-centered context. Although a context helps us - by narrowing the possibilities to likely notes and combinations - to assign an interval name to a sound, the context also result in a disadvantage, as you must examine so many contexts before you have grasped the property of an interval in all situations.

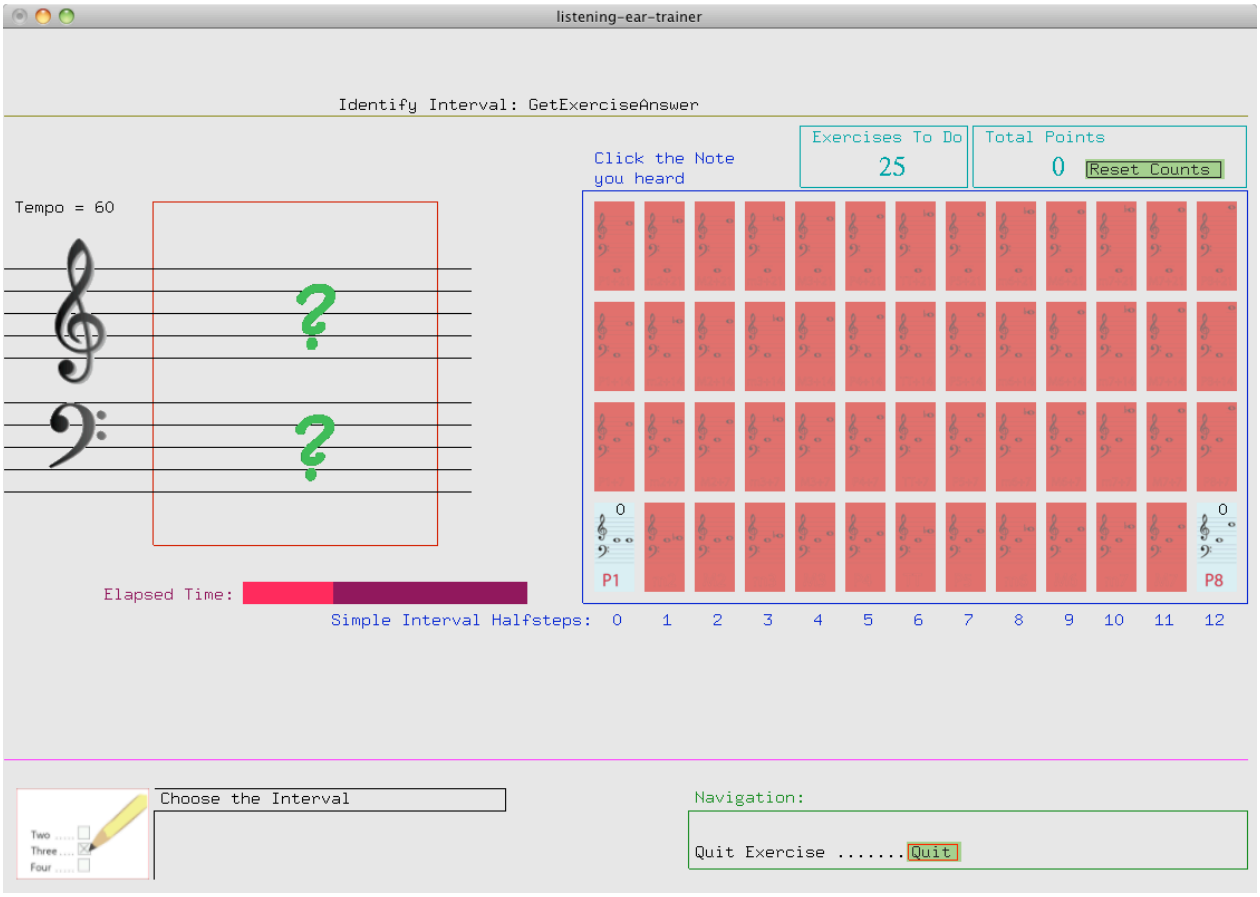
Our direct approach in acquiring the interval's characteristic relies on intervals already present in pitched sounds, as a relationship within the overtones a sound contains. And these characteristics (ratios) are the same for each starting pitch.

Therefore, we avoid the musical context and use the overtone effects of the series to grasp the characteristics of each interval. To reach that goal, however, a direct measure is needed to discern how close the pure interval characteristic is grasped. Our method provides this feedback. A count for each interval tells you how many times in a row you have answered this interval correctly. (An incorrect answer resets the count to zero.) When the count reaches 7 the color of the count for that interval changes to green and the number stops increasing. The interval will still be given as a question from time to time; so don't be surprised. But if not mastered, the interval will go back to the pool of non-mastered intervals (which all have a count of zero).

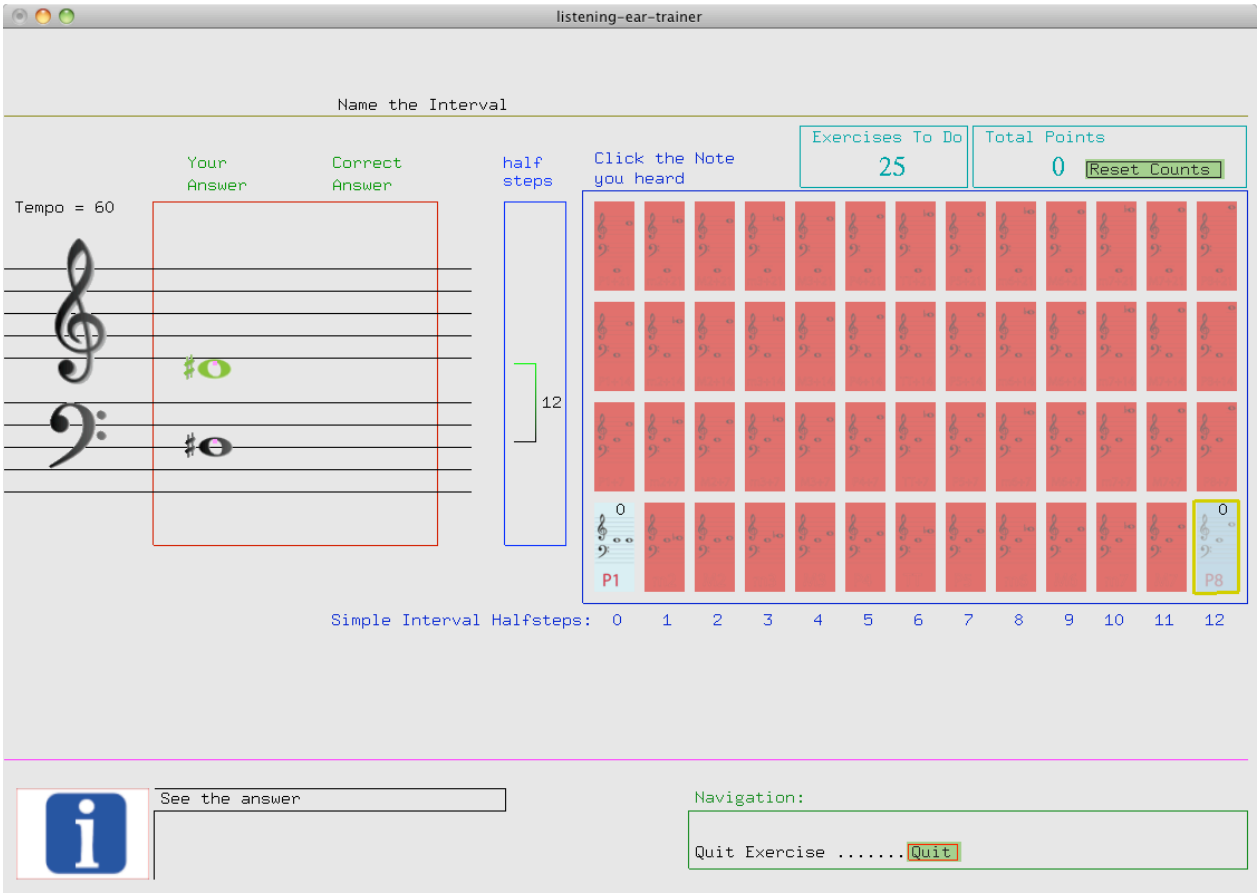
Since an overtone is a characteristic of the sound itself, interval identification by means of recognizing a special characteristic holds true independent of any musical context. However, for simplicity we will stick to the C Major scale as the only musical context for further explanations.

The Interval Overtone exercises

The first overtone is the Octave. Therefore the first intervals we will learn to distinguish are the Octave and the Unison. The Octave is the largest simple interval, which makes it easy to distinguish and grasp the characteristic of the interval. As mentioned earlier, try to hold the first note in your memory and grasp the interval characteristic of a Unison and an Octave as an interaction of two sounds (that is try to hear the ratio between the two pitches).

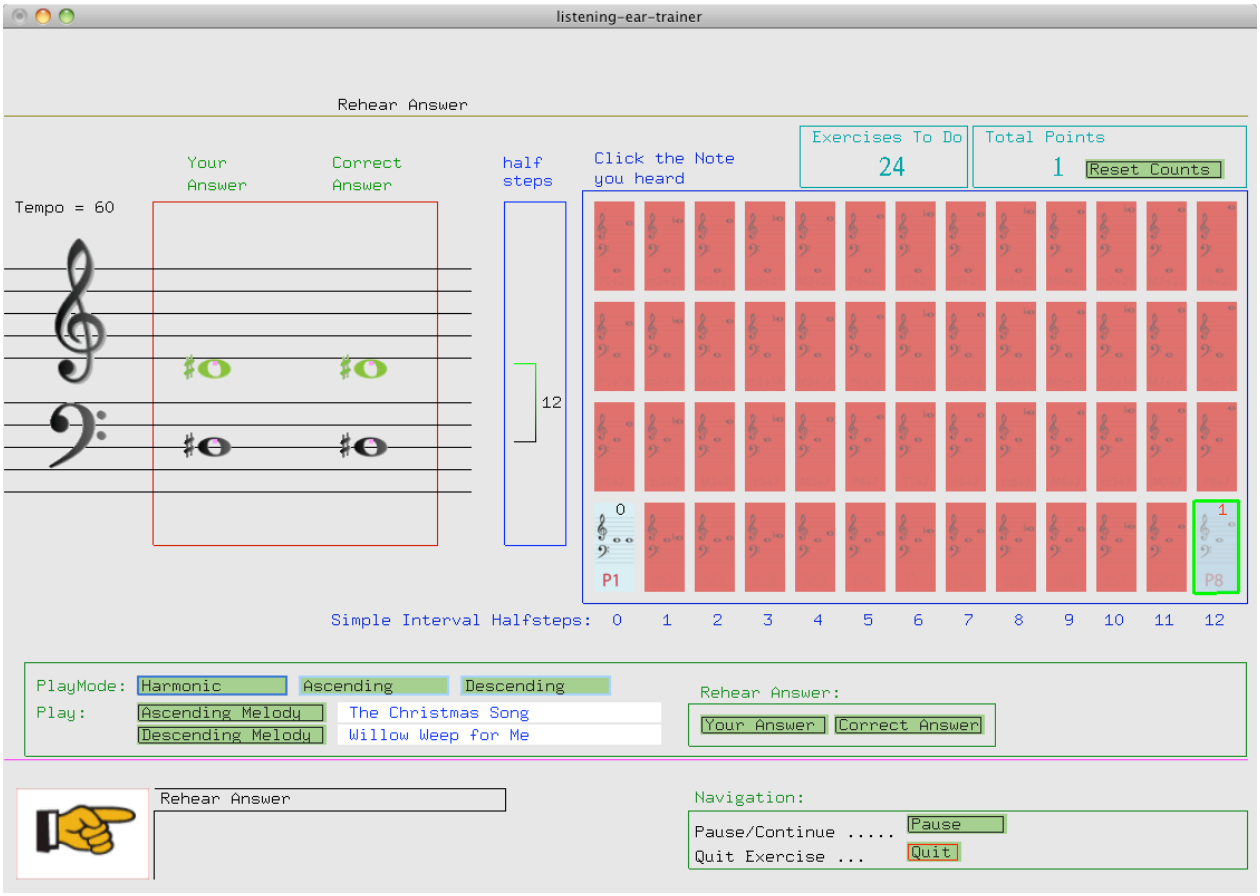


The exercise will play a melodic ascending interval: either a Perfect Unison or a Perfect Octave. Your task is to click on the appropriate button P1 or P8. Note that the tested intervals may fall outside C Major, so the starting sound might be a sharped note. However, your task is to identify the characteristic of the interval in itself, not in relation to a musical context (the notes are always depicted in the key of C Major). Absolute and relative pitch are two separate features even as they can support each other. We strongly recommend not trying to solve the exercises with absolute pitch, but to hear the relative properties of the intervals.



Once you have made your choice, your answer is displayed on the left side of the dialog box and played aloud. Then the correct answer is displayed on the right and played.

If you gave the correct answer, the hit-count in the button for that interval gets incremented. If you gave an incorrect answer, the counts for both your answer and the correct interval are reset to zero.



Note in the dialog box above that the count in the P8 button changed from a black zero to a red one.

You can now rehear your answer and/or the correct answer. This is a very important step you should not skip, if you were incorrect, for it allows you to discover in what way your answer was incorrect, and to hear in your head the difference between it and the correct answer. Compare the two intervals to figure out what characteristics you were watching for, and what characteristics you should have been listening for. What are the properties that make out that particular interval?

For better memorizing it helps tremendously if you can also listen to familiar, traditional songs that start with the interval in question. In a first step, learn the relationship song title and starting interval by heart, as you would learn a vocabulary. Don't worry about remembering the whole song or every musical detail. The brain learns the relationship between a melody and the song title just by listening to the song. So it is just the relationship of the song title to interval and interval to song title that you want to memorize first. In this way, for each interval name you always have an associated anchor melody or song with which you can compare. The absolute pitches of the song are most likely not the same as the absolute pitches played during the exercise, but the interval's characteristic is the same. The best learning process is to first discern the characteristic of the interval and then apply it to any absolute starting pitches.

The second overtone is the Perfect Fifth, which lies nearly in the middle of the octave and thus is easy to distinguish. (The Tritone is in the *exact* middle and therefore the largest distance away from the octave pitches at either end. So, why did we not choose the TriTone as the next interval

to learn? Because the method does not use the distances to grasp interval characteristics, but tries to discern overtones already present in the sounds. Since the Tritone is not the next tone in the overtone series, the magnitude of the Tritone's overtone is very small. And more important, since other overtones preceded the Tritone, many intervals will also be present in a TriTone. This leads to a much more complicated sound or frequency situation than we get when choosing the Perfect Fifth as our next interval to learn. The Perfect Fifth is the strongest overtone after the Unison and the Octave. It is important that you learn to distinguish the pure similarities with as few distractions as possible. Going step by step lends less confusion, since, if you are unsure, you can go back to the previous stronger and less complex sound relationships and compare against them.)

The third overtone lies at two octaves. Since we are only interested in simple intervals, we skip that overtone. The next overtone is a Major Third. But before we learn the Major Third, we will learn the Perfect Fourth.
Why? Because an interval consists of two sounds, we will also hear interactions of the second sound with the overtones of the first sound. Not only will you hear the interval C to G, a Perfect Fifth, but you will also hear G to the C an octave higher. While learning the Perfect Fifth you also hear the inverted relationship of G to C, or the Perfect Fourth.

G to C inverted, a Perfect Fourth, demands you pay close attention to differentiate it from the Perfect Fifth. Since the Perfect Fourth is already apparent (i.e. has sounded) while learning the Perfect Fifth, you will, in effect, continue learning to distinguish the Perfect Fourth. (In the graphic above, showing the harmonic series between the third and fourth harmonics, note that the first overtone is the second harmonic. Thus start counting overtones at the octave, and harmonics at the unison.)

The name we use, Interval Overtone Method, derives from the fact that the deviation of the overtone series is caused by the interval's own overtone of the fundamental pitch (that is we learn the Perfect Fourth before the Major Third).

After the Perfect Fourth, we continue with the next overtone sequence: the Major Third.

The inversion the Major Third interval is the minor Sixth, which is not part of the Major scale and thus less relevant as an overtone. The minor third between the 6th and 7th overtone is also not part of the Major scale. Even though the minor Third is an important part of triads, the overtones beyond the 5th overtone are already so weak that the combinations of previous overtones become more relevant. For example, a Major third plus a Perfect Fourth gives a Major Sixth. But let us continue with the overtone series.

The next overtone is G again, an octave higher, so we continue to the next overtone, Bb. The interval from C to Bb is not part of the C Major scale, but from Bb to C (first overtone) it is a Major Second, and the interval from Bb to G (second overtone an octave higher) is a Major Sixth. To make the learning process more symmetrical, the sequence used for the exercises goes from the Major Sixth to the Major Second.

The remaining major interval is the Major seventh.

Now, you have learned eight simple intervals. You could now continue to learn the five missing intervals to complete the octave. However, the exercises continue with simple harmonic intervals in order to establish confidence in the previously learned melodic intervals. Here we will learn the same eight simple intervals, and the strong overtone occurrences in the intervals.

After mastering the simple harmonic intervals, you will learn the compound intervals. The last exercise in the compound intervals section uses all intervals, including the less important overtone occurrences. Once you get to this exercise, we recommend you select the training mode and disable all new intervals but one. In this way, once you feel comfortable with the new interval, you can add the next until you have covered all intervals. Since the new intervals are all in between intervals already learned, you can learn to recognize them by comparing to the next, lower and higher, Major or Perfect interval. We suggest you start by adding the TriTone with its special characteristic, as it lies between the Perfect Fourth and Perfect Fifth. If necessary, you can also select the melodic ascending interval mode from the training options to familiarize yourself with the melodic characteristic of the new intervals.

Exercises: Relative Pitch

The exercises for relative pitch are built on the same principles as the Octave Anchor Pitches method. The goal is to learn to recognize specific interval characteristics. For this we use the learning box again. So the degree to which you have mastered the intervals gets assigned to pools of consolidated intervals. There are eight pools: 1) The novice pool, for those intervals not answered correctly, shows zero for the count of correct answers in a row. 2) Those intervals answered correctly seven times in a row are moved to the mastered pool. The other pools show intervals answered 1, 2, 3, 4, 5 and 6 times in a row. Intervals in lower pools are asked more often than intervals in the top pools. However, you have to answer the intervals correctly in the upper pools in order to move to the next pool, or to stay in the mastered pool. Otherwise the interval will be moved back to the novice pool.

The score continues indefinitely, so even when you have reached the maximum possible points, you can continue testing yourself. Starting an exercise sets the exercises to do count to 25. But does not reset the score, and the hit count for each note stays where you left it last time.

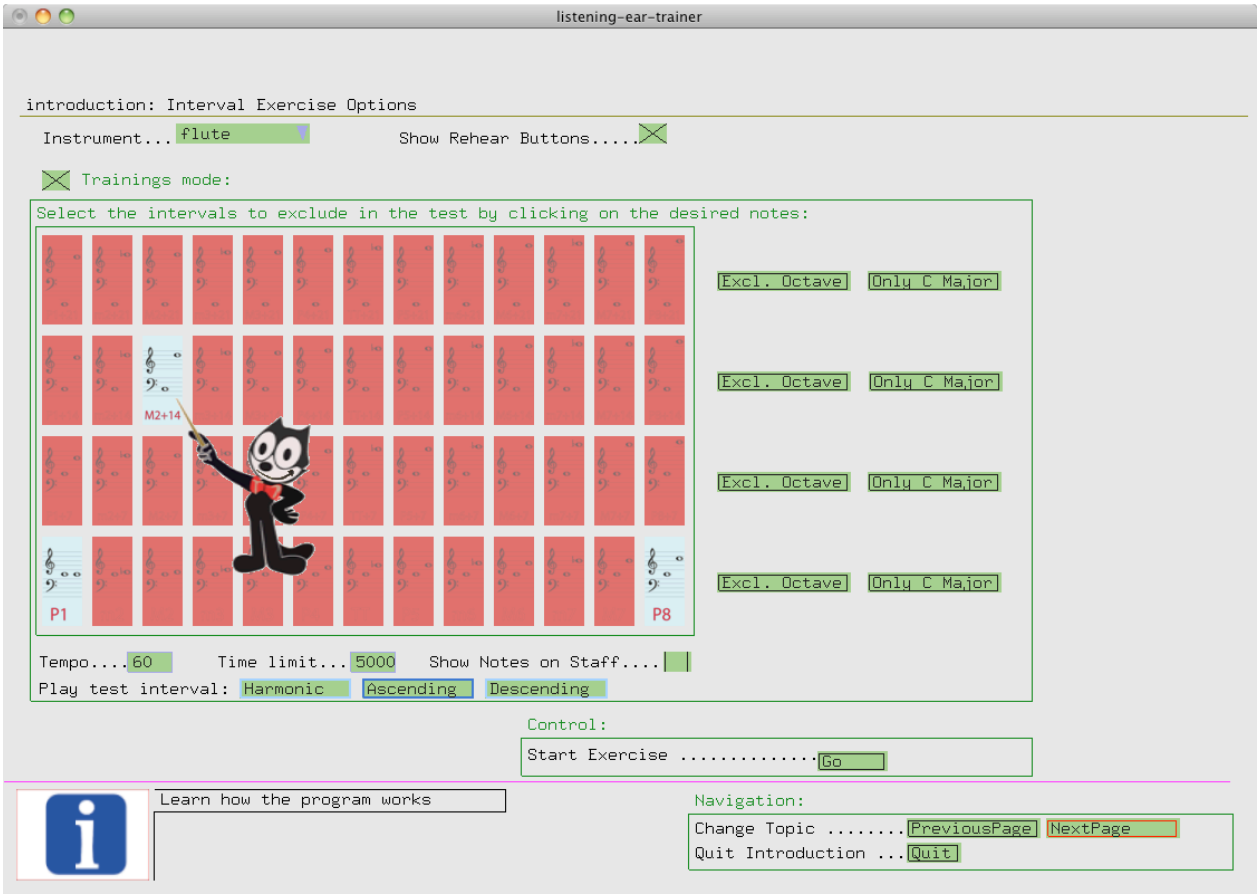
There are a maximum number of points you can make in each exercise, but to reach the maximum is not the main goal. The continued improvement in fluency and accuracy remain higher goals of the learning process. When learning a foreign language, repetition plays an important role. The same is true for learning intervals, or other musical concepts.

Ascending Intervals

Recognizing Ascending P1 and P8

The beginning exercise for the “Interval Overtone” method is to recognize ascending Perfect octaves and unisons.

Before you start an exercise you have the possibility to set some options by selecting the “Show exercise options” in the lesson dialog box.



Similar to the Octave Anchor Pitches method you can select Trainings mode to include and exclude individual intervals, if you wish to do training outside the curriculum.

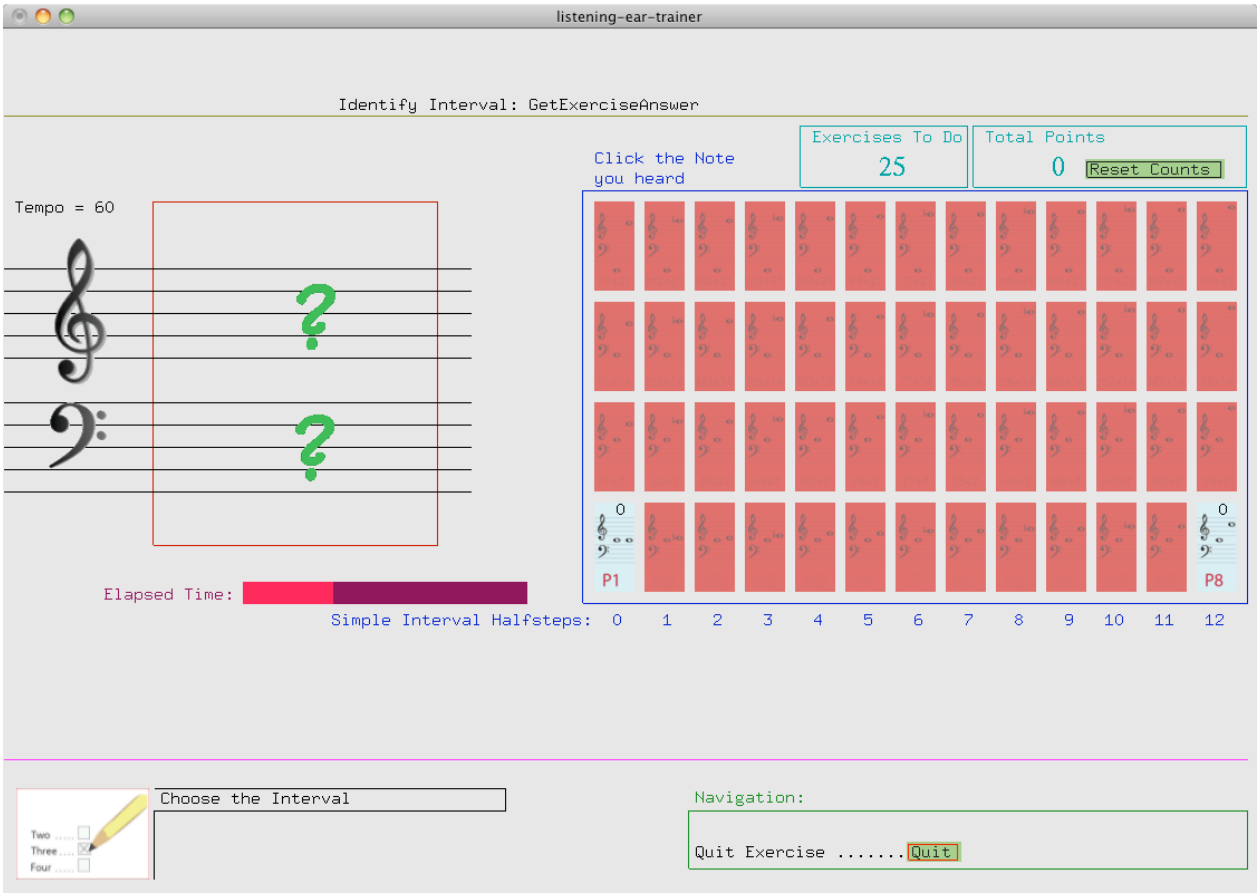
Here the following options are available:

- Instrument:
  Here you can select “flute” or “Sinus.” The Sinus sounds are pure and should produce fewer overtones in your headset or speakers. In training mode a male voice can be selected that will sing the solfège syllables. Attention: If you set the instrument to “Sinus” you will need a good headset to hear the low notes. Mediocre loudspeakers tend to fail

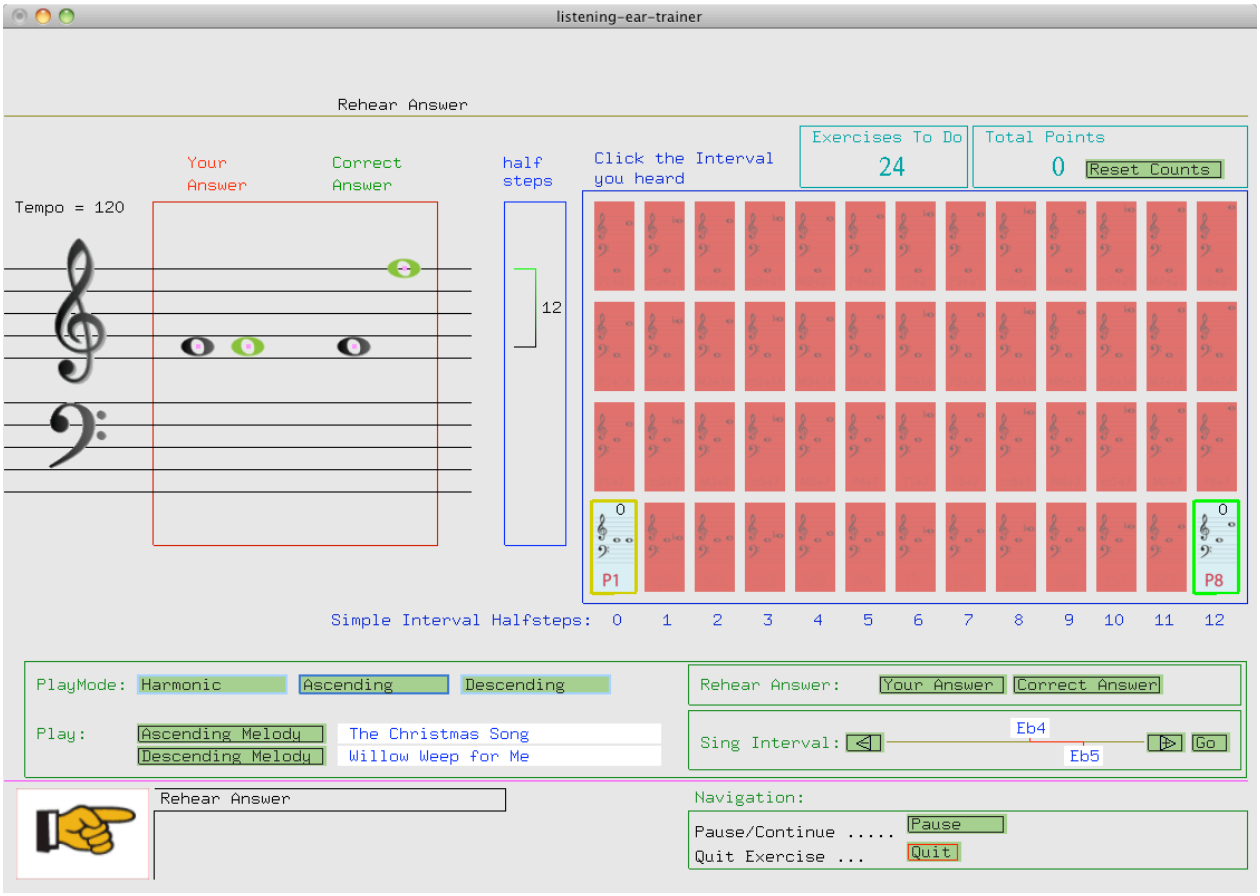
when reproducing frequencies below A2 (110 Hz). The flute sound has more overtones and thus will be easier to hear.

- Show Rehear Buttons:
  After each test this option will display two buttons that allow you to rehear your answer, or the correct solution. This helps you to better understand your error. If you do not hit one of the two buttons, the test continues with the next note after a second or two.
- Training mode:
  If selected additional training options are available.
- Exclude/include intervals:
  In training mode you can include or exclude a single interval by clicking on that interval. By clicking on "Exclude Octave," you exclude the whole octave from the test. By pressing "Only C Major," you select only Perfect and Major intervals of the C Major scale.
- Tempo:
  The tempo setting allows you to adjust the length you will hear the interval in order to detect the interval. Lower tempo values will increase the length of time the interval is sounded and higher values will decrease this length. The shorter the time in which you listen to the sound, the more difficult it becomes to assign an interval-name to the sound. The selected speed sets the duration of harmonically played intervals with whole notes. Melodic intervals will be played at double that speed, so that the whole time to detect the interval name is the same as for harmonically played intervals (the note values do not change: they stay a whole note).
- Time limit:
  The time limit setting allows you to limit the time in which to identify the note. Shorter times give less time to go through your inner repertoire of sounds. Longer times allow you to compare and reconcile the sound before you have to respond.
- Show notes on staff:
  During the questioning the notes will be displayed. This helps, if you want to learn to find interval names from the staff.
- Harmonic, Ascending, Descending:
  With these buttons you can set the play mode of the interval during the questioning.

When done with option selections, click "Go." The exercise will start with the selected options. The exercise window appears as follows:



The sound of the interval to be identified will be played and question marks displayed on the staff. Your task is to click the correspondingly available interval symbol you hear. In this exercise only the Perfect Unison and Octave are tested. Below the staff the time remaining to answer the question is displayed. For the melodic interval mode the countdown will start when the second note is sounded.



In the above screenshot the P1 interval was chosen (Your answer is logged with a yellow frame). A P8 interval was played (the correct answer is in a green frame). In addition, the option "Show Rehear Buttons" was chosen in order to compare your answer again to the correct answer by clicking one of the buttons in the "Rehear Answer" frame.

Remember, you can choose to rehear the intervals ascending or descending melodically, or harmonically.

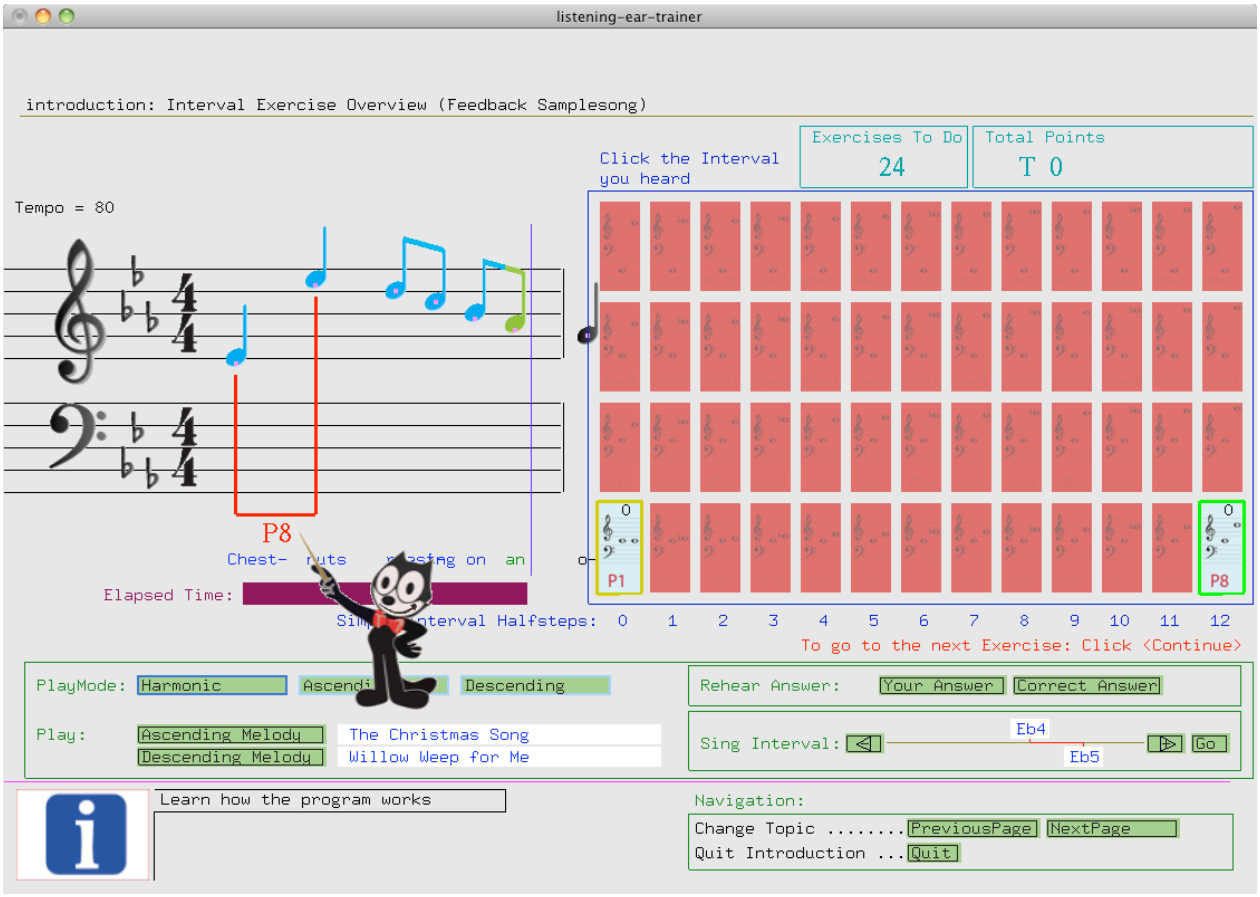
Each interval button contains a counter in the upper right corner, which shows you how many times you have correctly answered an interval in a row without making an error. This counter refers also to the pools mentioned earlier in the "Exercises: Relative Pitch" chapter. The counter stops increasing after 7 correct responses, so the maximum points you can reach for this exercise is 14 (the 2 interval exercises—P1 and P8—multiplied by 7).

The exercise continues indefinitely, so even when you have reached the maximum points, and finished the exercises, you can keep testing yourself. The next time you start the exercise, you start with the same score as when you finished last time.

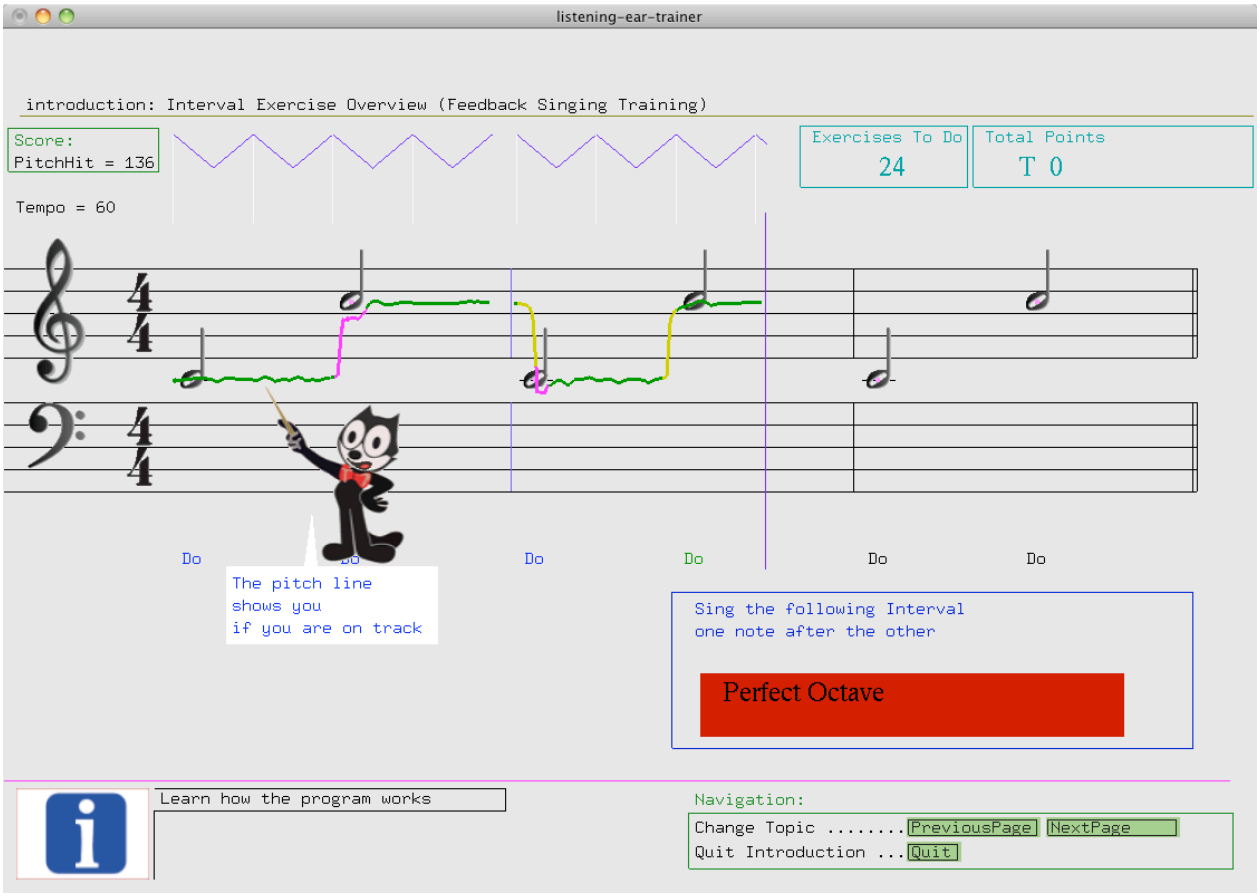
You can also reset all counts to zero by pressing the button "Reset Counts," which will return you to the very beginning of the exercise for all intervals. Every exercise has its own counter, so "Reset Counts" will only reset the scores for that particular exercise.

You also have a choice of listening to the beginning of a familiar or memorable song, with

intervals in ascending or descending order, to connect the song and its opening interval's name.


listening-ear-trainer
introduction: Interval Exercise Overview (Feedback Samplesong)
Exercises To Do
24
Total Points
T 0
Click the Interval you heard
Tempo = 80
P8
Elapsed Time:
Interval Halfsteps: 0 1 2 3 4 5 6 7 8 9 10 11 12
To go to the next Exercise: Click <Continue>
P1
P8
PlayMode: Harmonic Descending
Play: Ascending Melody The Christmas Song
Descending Melody Willow Weep for Me
Rehear Answer: Your Answer Correct Answer
Sing Interval: Eb4 Eb5 Go
Learn how the program works
Navigation:
Change Topic ..... PreviousPage NextPage
Quit Introduction ... Quit

To improve your interval memorizing even further, you can move the interval in question to your singing range and start singing the interval.



Unfortunately, the first interval in the curriculum is the Perfect Octave. This is good for the learning to differentiate interval characteristics, however, to sing the interval is not easy. Since the notes are a whole Octave apart, your voice muscles must perform a large change. Therefore, we recommend that you postpone the singing training until the intervals come to a comfortable range for you. Tip: if going down from a high note to a low note, do not sing the high note until the end. Rather take a little time to prepare your muscles for the low note (relaxing the muscles takes longer than tensioning). Since the first intervals P1, P8 and P5 are easy to distinguish, it is a good point to start the singing training with the Major third. In this way you will get a new orientation point for the interval property of the Major third.

Adding Ascending P5

This exercise adds the interval for the Perfect Fifth, which has the strongest overtone of any note after the octave. Any pitched instrument already contains the sound of the Perfect Fifth as an overtone; therefore you should learn to differentiate the characteristics of the Perfect Fifth from those of the Perfect Unison and Octave. It is strongly recommended that you wait until you have mastered differentiating the Perfect Unison and Octave before starting this exercise.

Adding Ascending P4

Since in a harmonically played interval the pitch an octave higher of the lower note will also be present as an overtone, so the interval of a Perfect Fourth can also be heard when playing a Perfect Fifth. Thus when you are learning to differentiate the Perfect Fifth, you will also be

hearing its inversion, a Perfect Fourth. In order not to confuse these with other intervals, you should learn in the next step to differentiate a Perfect Fourth from a Perfect Fifth. All intervals will contain to a certain degree the same overtones and thus the same intervals. Your task is to learn to detect or recognize the nuances of intervals from their sounds. The characteristic of a Perfect Fourth prevails over that of its inversion of a Perfect Fifth, which carries the Perfect fourth only as an interval of an overtone of its fundamental, or starting pitch.

Learning to listen for and identify the specific sounds of the Perfect Unison, Octave, Fifth or Fourth constitutes the basic skills you should acquire. Because these intervals will be present in all ensuing intervals, identifying them is required before you continue. This way you can rule out these intervals definitively, in mastering the other intervals. Be sure you can name these intervals without any doubt, so you can concentrate on learning the characteristics of the remaining intervals.

Adding Ascending M3

The next relevant overtone of any fundamental or starting pitch lies a Major Third distance away and its interval is the Major Third. To avoid confusion in learning the remaining intervals, we proceed first with the Major Third. Again, if you have ensured complete accuracy in identifying the previous intervals, the Major Third will be less challenging to learn.

Adding Ascending M6

As explained in the introduction, the method continues with the Major Sixth before the Major Second. Both intervals appear as we continue with the overtone series and their inverted intervals. We tackle the Major Sixth before the Major Second because it balances to a greater degree the previous interval.

Adding Ascending M2

Learning the ascending Major Second completes the above overtone series in our repertoire of intervals.

Adding Ascending M7

Finally, we learn the last interval of the major scale: the Major seventh, which has a strong tendency to resolve to the octave of the fundamental. That is why it is called the leading tone, and this makes it relatively easy to recognize the interval within a melodic context.

Harmoniv Intervals

Recognizing Harmonic Intervals P1 and P8

In the previous exercises, melodic intervals were presented. In order to distinguish characteristics of each interval as it was presented you had to keep the first given note in mind. At first glance, this may have seemed more difficult than simply listening directly to the relationship between two notes played simultaneously. However, since we can only sing one note at a time, it is much

easier to show the relationship in a melody than in a musical piece where the notes are played simultaneously or harmonically. References to familiar or simple songs make it easier to remember and compare other intervals to the interval in question.

In the next exercises, therefore, we learn to extract the characteristics of simultaneously played notes. Such characteristics are the same as for melodic intervals, so you will already have the necessary skills to identify each interval. You merely have to practice recognizing them in a different, specifically vertical, arrangement. In case of doubt, you can return to and listen to the melodic interval with your inner ear. The order in which you will learn the harmonic intervals is the same as for the melodic intervals, beginning with the Perfect Unison and Octave.

Adding Interval P5

Then add the Perfect Fifth to your repertoire.

Adding Interval P4

Then add the Perfect Fourth ...

Adding Interval M3

... the Major Third ...

Adding Interval M6

... the Major Sixth ...

Adding Interval M2

... the Major Second ...

Adding Interval M7

...and, finally, add the Major Seventh to your repertoire.

Compound Intervals

Recognizing Compound Intervals P1 and P8

So far we have only covered simple intervals. Compound intervals, are larger than an octave and, since the octave is such a strong overtone, it is often treated as irrelevant to illustrate musical concepts. Of course, compound intervals have their own characteristics, but since the upper sound is much farther away, mastering the identification of octaves is better done through an absolute approach. Thus you should use the Octave Anchor Pitches method to differentiate the octaves of the two given pitches.

The following exercises are excellent applications for the Octave Anchor Pitches method. You will also find it helpful to assign a pitch to an octave number, or locate it in relationship to the octave.

For compound intervals, the use of an identifying familiar song does not work as well, as you must transpose the interval up or down an octave, and thereby distort the song unrecognizably. Also, since large intervals are difficult to sing, they rarely exist in such songs. Nevertheless, hearing compound intervals forces you to listen for similarities of quality that span over an octave.

We begin with P1, P8, P15 (two octaves), and P 23 (three octaves).

Adding Compound P5

We continue by adding P5, P12 (one octave plus P5), and P 19 (two octaves plus P5).

Adding Compound P4

We continue by adding P4, P11 (one octave plus P4), and P 18 (two octaves plus P4).

Adding Compound M3

We continue by adding M3, M10 (one octave plus M3), and M17 (two octaves plus M3).

Adding Compound M6

We continue by adding M6, M13 (one octave plus M6), and M20 (two octaves plus M6).

Adding Compound M2

We continue by adding M2, M9 (one octave plus M2), and M16 (two octaves plus M2).

Adding Compound M7

Finally we add the M7, M14 (one octave plus M7), and M21 (two octaves plus M7).

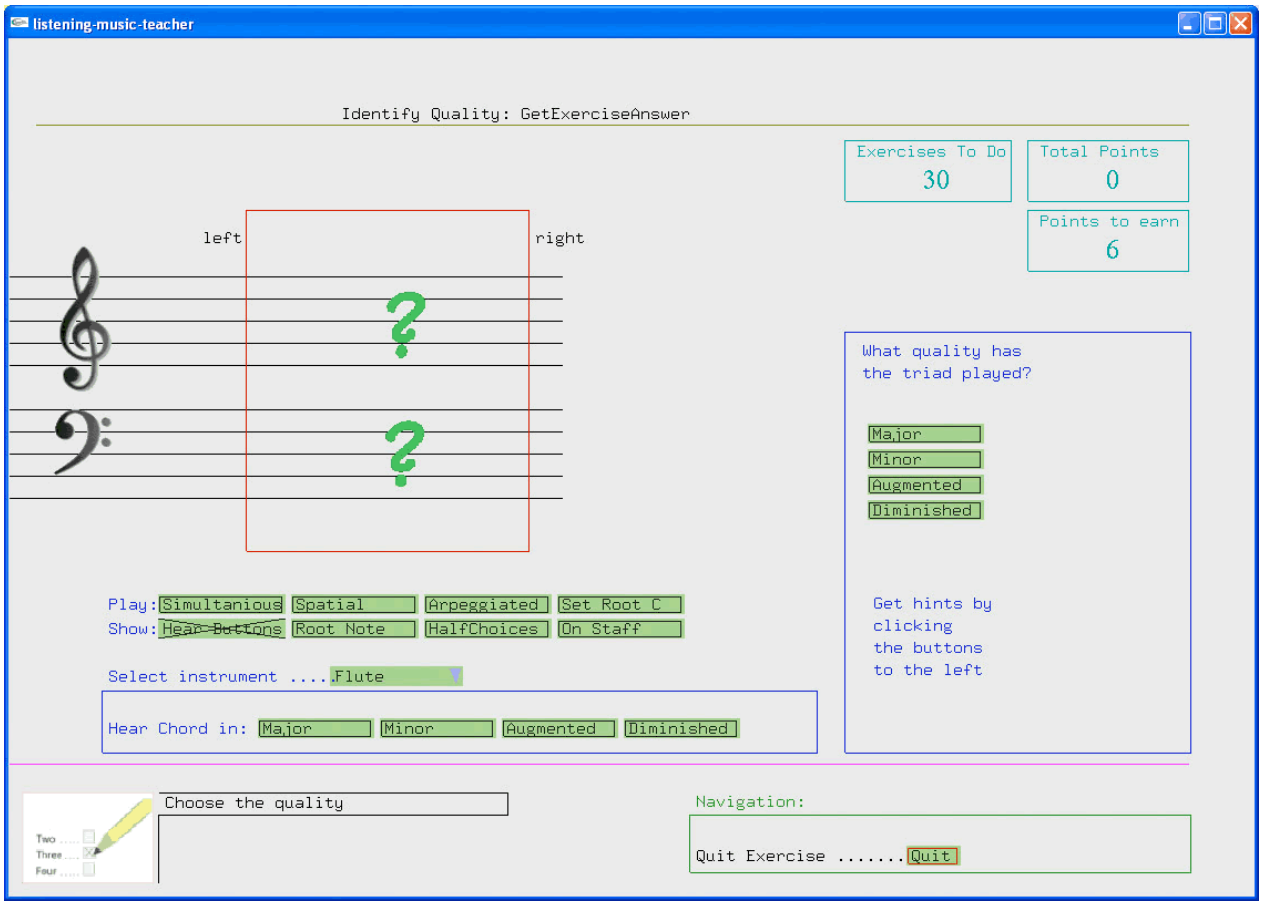
Recognizing the Interval

In this exercise you learn to recognize all intervals, including TriTones and Minor intervals. When you first start this exercise, we recommend you use the training mode for limiting the interval exercises to only a few new ones. For example, start by learning the Tritone, and then add the Minor third. Remember: All the remaining intervals lie in between intervals you have already learned. So you should try to relate them to the lower and upper intervals you already know, those that encompass the new interval.

When you finish, go back to the full exercise mode so you can increase your score in the lesson dialog box.

Recognizing the triad quality

The last exercise introduces the triad. There are four qualities of triads, and these become more difficult to identify in triad inversions. The sound patterns of the triad quality lie closer together than those of triad inversions. This makes the task of learning triad qualities and triad inversions a little more difficult, but you will get a feeling for these qualities before long.



In the beginning you might even reduce the number of possible answers to two ("Half Choices"). After awhile your scores will improve.

In this exercise you are encouraged to use as few hints as possible in order to earn as many points as possible.

This triad exercise is from Listening Music Teacher, our method for learning music theory, which has exercises for recognizing triads and seventh chords.

Recommendations

For musicians, ear training is necessary in order to recognize relative pitch differences. It helps them to stay in tune with others, even if a piece is played on a tuning system other than equal temperament.

Still, one should try to develop a feeling for where the pitches are individually, or absolutely, without relation to other pitches. Otherwise, if you construct everything in terms of relative pitch and your relative pitch is not flawless, you may drift away from the key, or end up a semitone or more off key, and not know it.

To ensure keeping on key and tracking your progress, you should do both exercise types: the Singing Funnel method and the Octave Anchor Pitches method.

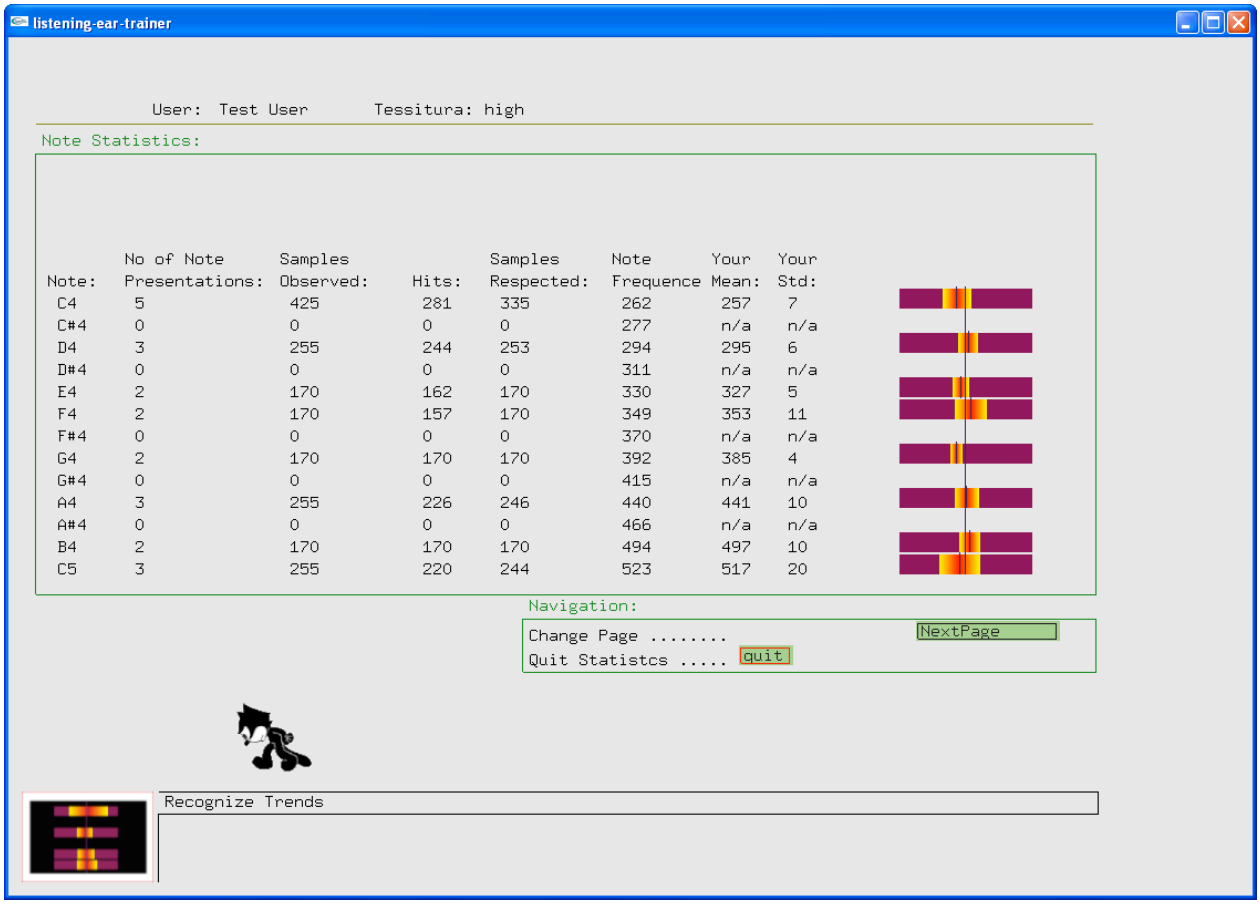
Many studies show that the easiest way to acquire absolute pitch is during childhood. The Singing Funnel method encourages your brain to revert to a mode similar to when you first learned to utter sounds. During this period you also learned to control your vocal cords by listening to your efforts. The visual feedback of the Singing Funnel method makes it simple to regain that awareness and control.

As a last tip: use Fixed Do solfège syllables to associate sounds to pitch names. (Fixed Do is a naming system that assigns one syllable to a pitch, used for any music or exercise, whereas in the Movable Do system, the syllables "move" to correspond to the scale degrees—the fundamental note of the key being $\hat{1}$—of whichever key the piece or exercise is in.) For singing warm-ups and scales use scale degree numbers ($\hat{1}$, $\hat{2}$, $\hat{3}$, $\hat{4}$, $\hat{5}$, $\hat{6}$, $\hat{7}$, $\hat{8}$). These numbers more clearly represent the function of a note within the scale than do solfège syllables.

Statistics

Pitch Center Tendency Statistics

The program collects statistics data to help you identify your weaknesses. In the “Select Lesson” screen, instead of choosing a lesson, you can see the statistics by pressing the statistics button.


listening-ear-trainer
User: Test User
Tessitura: high
Note Statistics:
Note: | No of Note Presentations: | Samples Observed: | Hits: | Samples Respected: | Note Frequence | Your Mean: | Your Std:
C4 | 5 | 425 | 281 | 335 | 262 | 257 | 7
C#4 | 0 | 0 | 0 | 0 | 277 | n/a | n/a
D4 | 3 | 255 | 244 | 253 | 294 | 295 | 6
D#4 | 0 | 0 | 0 | 0 | 311 | n/a | n/a
E4 | 2 | 170 | 162 | 170 | 330 | 327 | 5
F4 | 2 | 170 | 157 | 170 | 349 | 353 | 11
F#4 | 0 | 0 | 0 | 0 | 370 | n/a | n/a
G4 | 2 | 170 | 170 | 170 | 392 | 385 | 4
G#4 | 0 | 0 | 0 | 0 | 415 | n/a | n/a
A4 | 3 | 255 | 226 | 246 | 440 | 441 | 10
A#4 | 0 | 0 | 0 | 0 | 466 | n/a | n/a
B4 | 2 | 170 | 170 | 170 | 494 | 497 | 10
C5 | 3 | 255 | 220 | 244 | 523 | 517 | 20
Navigation:
Change Page ....
NextPage
Quit Statistcs .....
quit
Recognize Trends

The statistics are organized in several pages:

- Pitch statistics for the note range C4 – C5
- Pitch statistics for the note range C3 - C4
- Pitch statistics for the note range C2 – C3
- Pitch statistics for the note range C5 – C6

The pitch statistics appear as in the above screenshot. There are nine columns:

- Note
  In this column the note name is displayed under Note. Solfège syllables correspond as follows to the note names:
  - Syllable --> Note name
  - Do --> C
  - Di/Ra --> C#/Db
  - Re --> D

- Ri/Me --> D#/Eb
- Mi --> E
- Fa --> F
- Fi/Se --> F#/Gb
- So --> G
- Si/Le --> G#/Ab
- La --> A
- Li/Te --> A#/Bb
- Ti --> B

Be aware that neither E# or B# are represented in the statistics box. E# is the same note as F and B# the same as the C at the top of the scale. The numeral after the note name (e.g. the 4 after C in C4) denotes the octave. On the piano A0 is the lowest key. Middle C is C4.

- Number of Note Presentations
  This column tells you how many times the note was presented in a pitch exercise.
- Samples Observed
  The number in this column shows how many pitch sample points belonging to this pitch were observed. Longer notes have more observation points than short notes.
- Hits
  The number in this column tells how many of the observed samples resulted in a pitch hit, or correct answer (where the pitch frequency was within the predefined limits).
- Samples Respected
  Since pitch sensitivity can be varied, the number of notes that fulfill the criteria for a correct hit depends on the chosen sensitivity. For the statistics reading, all samples falling at a distance range of +/- two half-steps away from the given pitch are acceptable, no matter the chosen sensitivity. If a narrow sensitivity was chosen, this number is usually higher than the number of hits. By contrast, a very broad sensitivity may result in fewer acceptable answers.
- Note Frequency
  This column displays the note frequency in Hz.
- Your Mean
  This column shows the calculated mean frequency in Hz from the acceptable samples of your performance.
- Your Standard deviation
  The number in this column is the calculated standard deviation. The smaller the number, the less your pitch observations overall deviate from the defined frequency.
- Graphical Display of the mean and standard deviation

This column graphically shows you your mean pitch and variation around the pitch in terms of its relation to the real frequency.

Chronological statistics

A chronological statistic of your progress is described in the next chapter “Inside our Methods”: Tracking the Progress

Inside our Methods

For Absolute Pitch training trying to imitate a pitch through our vocal cords seems to be the most effective way to grasp a sense for absolute pitch. Since we use the same muscles for to speak as for singing a pitch, our methods use the same techniques as for learning a foreign language.

For Relative Pitch training we isolate interval characteristics along the way: overtones, - and therefore intervals -, occur. By learning the interval characteristics in the order as they appear naturally, we can use an exclusion approach to identify new interval characteristics.

Pitch recognition skills

Pitch recognition exists in many forms:

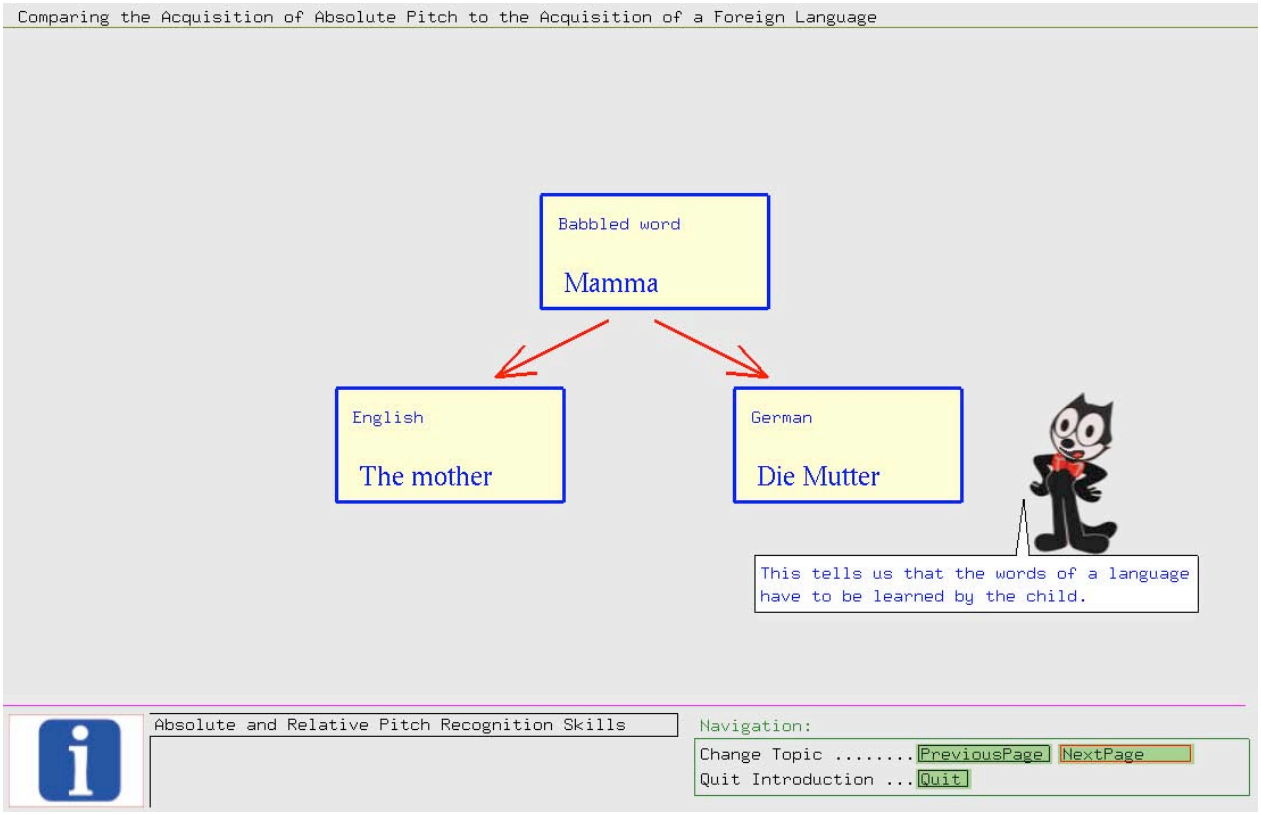
- recognition of specific pitched sounds (e. g. we recognize that the dial tone was the same as last time, and the times before.). There are many, pitched or un-pitched, sounds that we can relate to specific events
- recognition of a melody regardless of the key in which it is played .
- recognition of instruments
- recognition of a single note relative to a tonal reference
- recognition of the tonal center (key)
- recognition of a single note without a tonal reference
- recognition of a whole series of notes with pitch and rhythm characteristic
- recognition of intervals, triads, seventh chords and other simultaneously played notes.
- Recognition of single tracks of an arrangement
- Recognition of whole arrangements

This variety of sound recognition suggests that pitch recognition should be present in some form in all humans. Similar to the fact that we can abstract and understand words from totally unknown people, we possess some ability to deal with pitch.

Absolute pitch is usually associated with the ability to recognize the 12 notes in a chromatic scale in the Western equal temperament. Since the majority of the people cannot identify a single pitch by name, some people assume that absolute pitch is a genetic trait that cannot be learnt. Others claim that absolute pitch can only be acquired by people who had musical training by the age of five.

Psychologist Diana Deutsch, UC-San Diego, relates perfect pitch to speech and speech acquisition. We take this approach a step further and compare it to the acquisition of a foreign language.

Comparing the acquisition of pitch to the acquisition of a foreign language


Comparing the Acquisition of Absolute Pitch to the Acquisition of a Foreign Language
Babbled word
Mamma
English
The mother
German
Die Mutter
This tells us that the words of a language have to be learned by the child.
Absolute and Relative Pitch Recognition Skills
Navigation:
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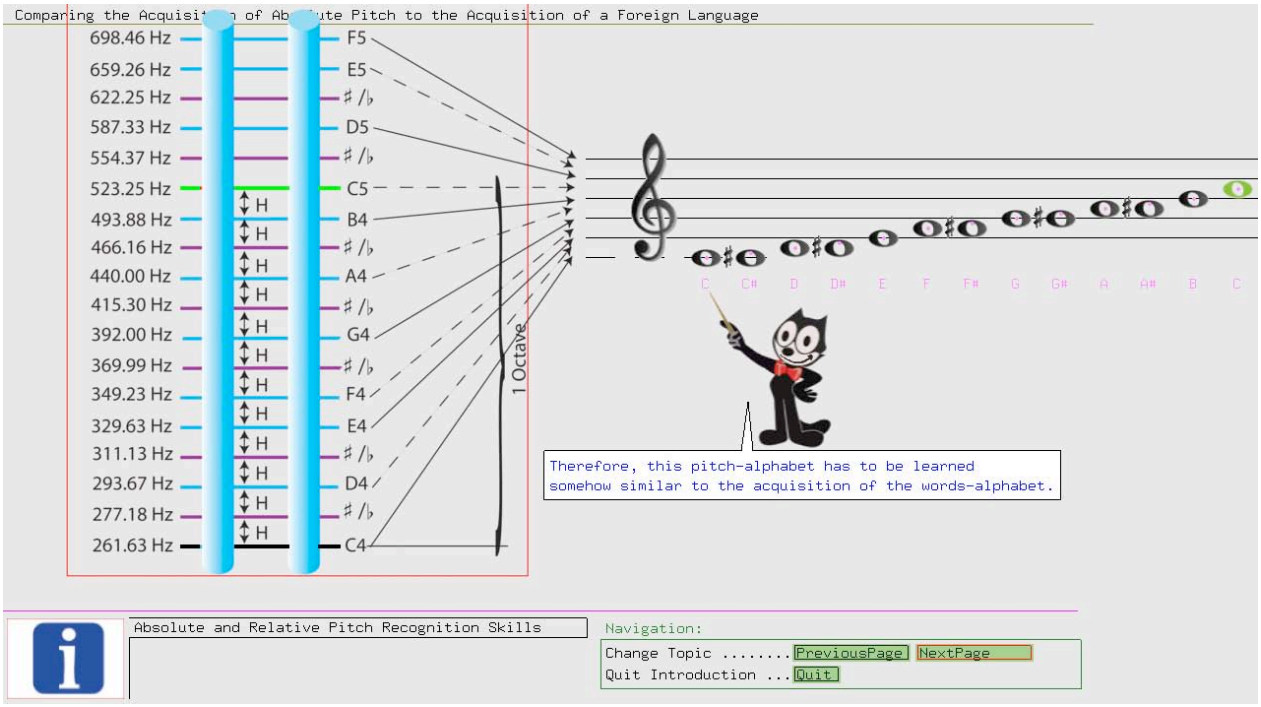
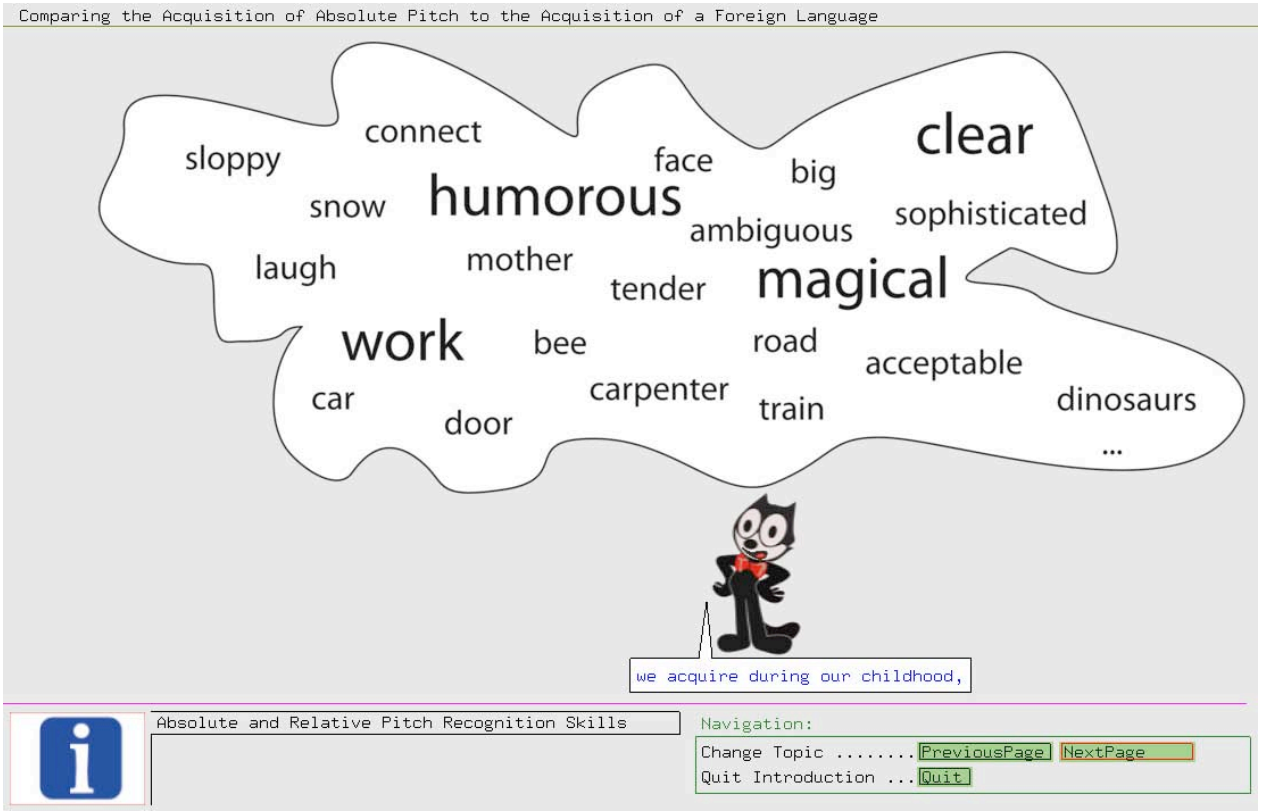
Quit Introduction ... Quit

First, we see that there is no innate word for “Mamma”, - usually the first word a child speaks. The term mamma is built up from speech sounds that are easiest to produce. The English representation of the word is: mother. In German, for example, the word for mother is: Mutter. Therefore, the words of a language have to be learned by the child.

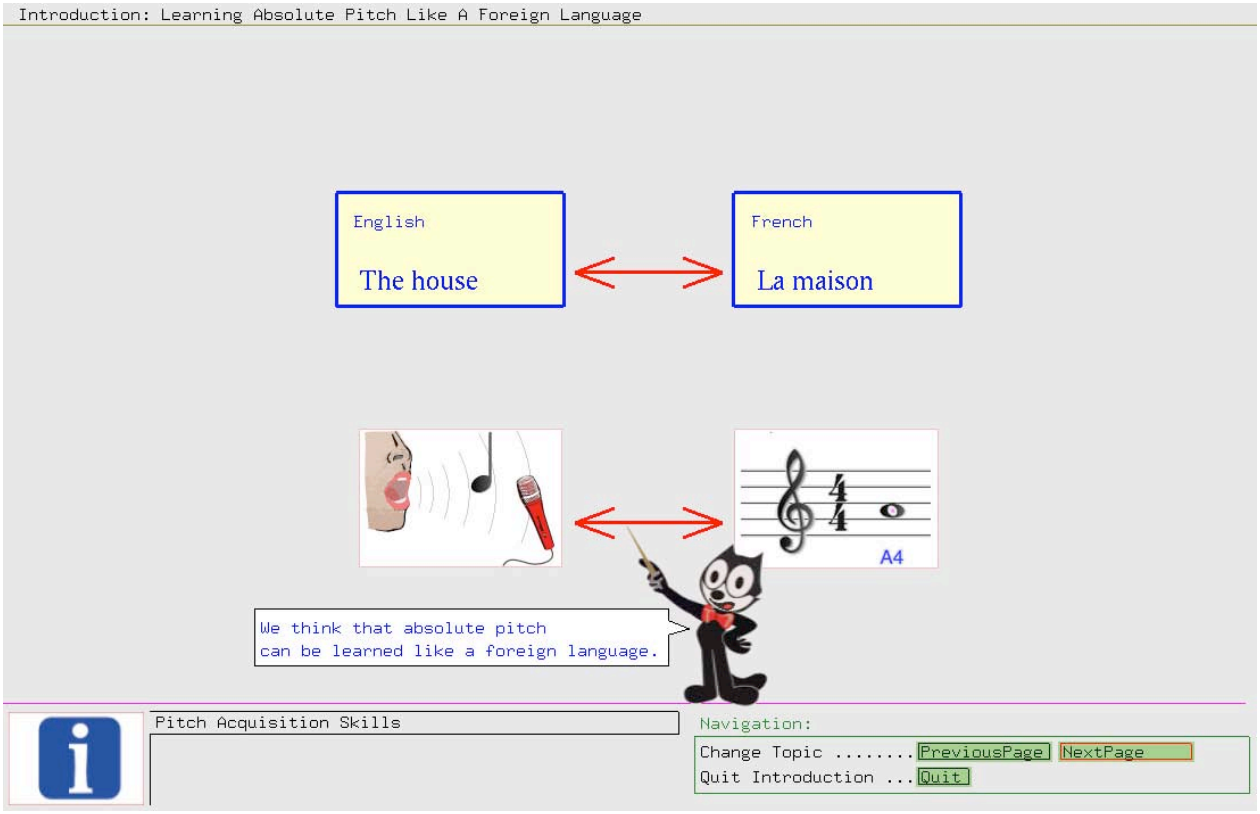
Since the pitch-alphabet is man-made, the same rule applies: it has to be learned similar to the acquisition of words.



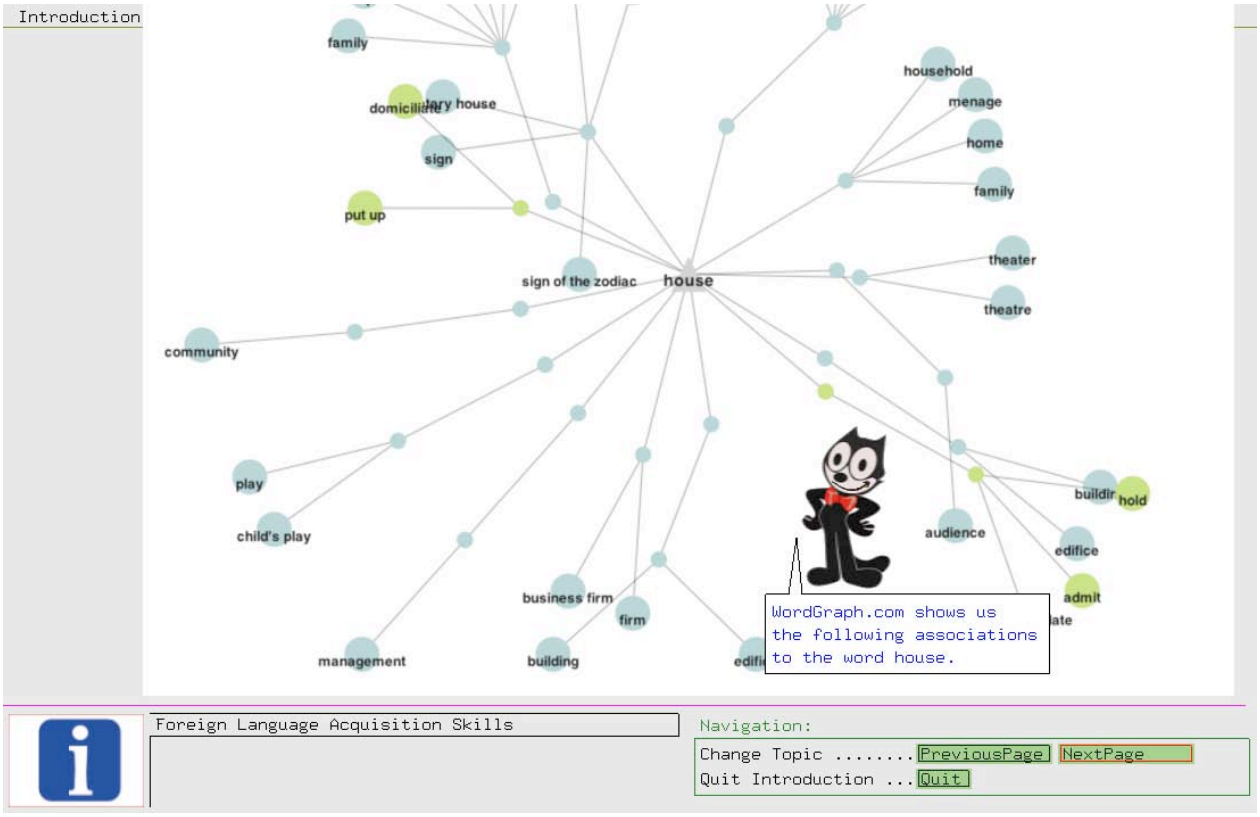
Second, the biggest part of our vocabulary of our native language, we acquire during our childhood; - seemingly without effort and active learning.



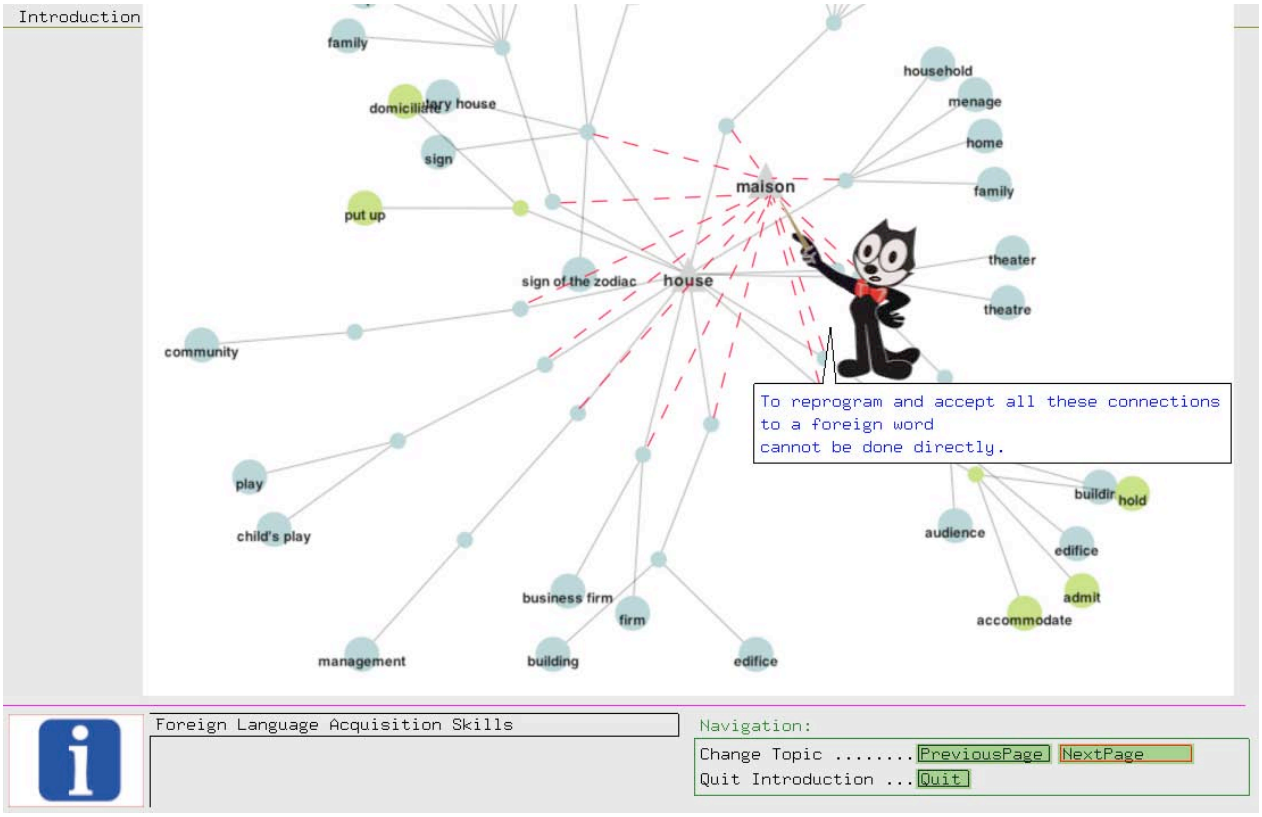
The same is probably true fort he acquisition of the pitch vocabulary. However, since we do not use the pitch memory intensively, and there is no merit of having absolute pitch during childhood, we do not develop pitch associations and instead prefer to acquire relative pitch skills. Most people can identify melodies, regardless of the key in which the melody is played. Thus proofing that they have acquired a certain degree of relative pitch. This ability is an obstacle to acquiring absolute pitch. The brain will try to solve questions about pitch with relative pitch skills.



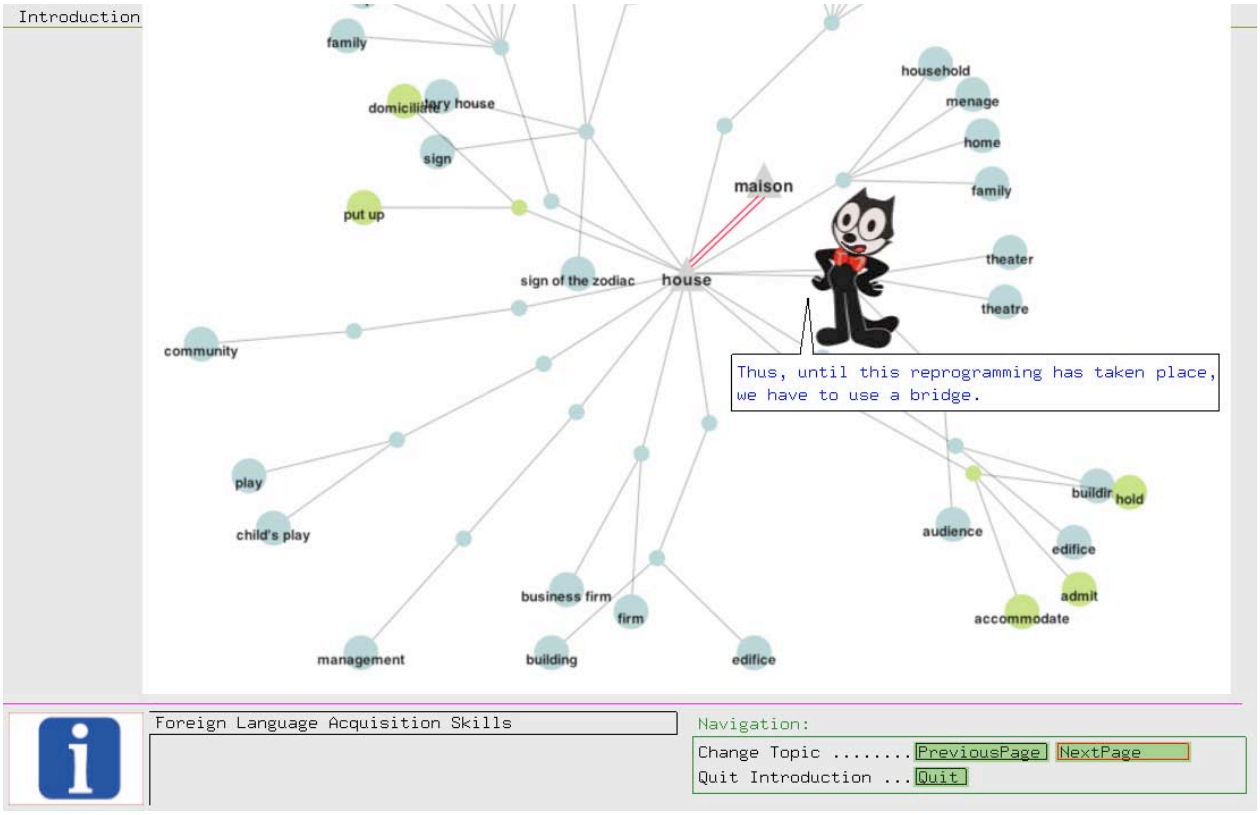
A similar learning situation exists when we want to learn a foreign language: The later we try to learn a foreign language, the more difficult it will be to abandon the learned patterns of our native language. In a way we have to abandon the strong associations between objects and their native word representation. When learning a foreign language, we have to create a new foreign word representation for that object. WordGraph.com shows us the following associations to the word house:



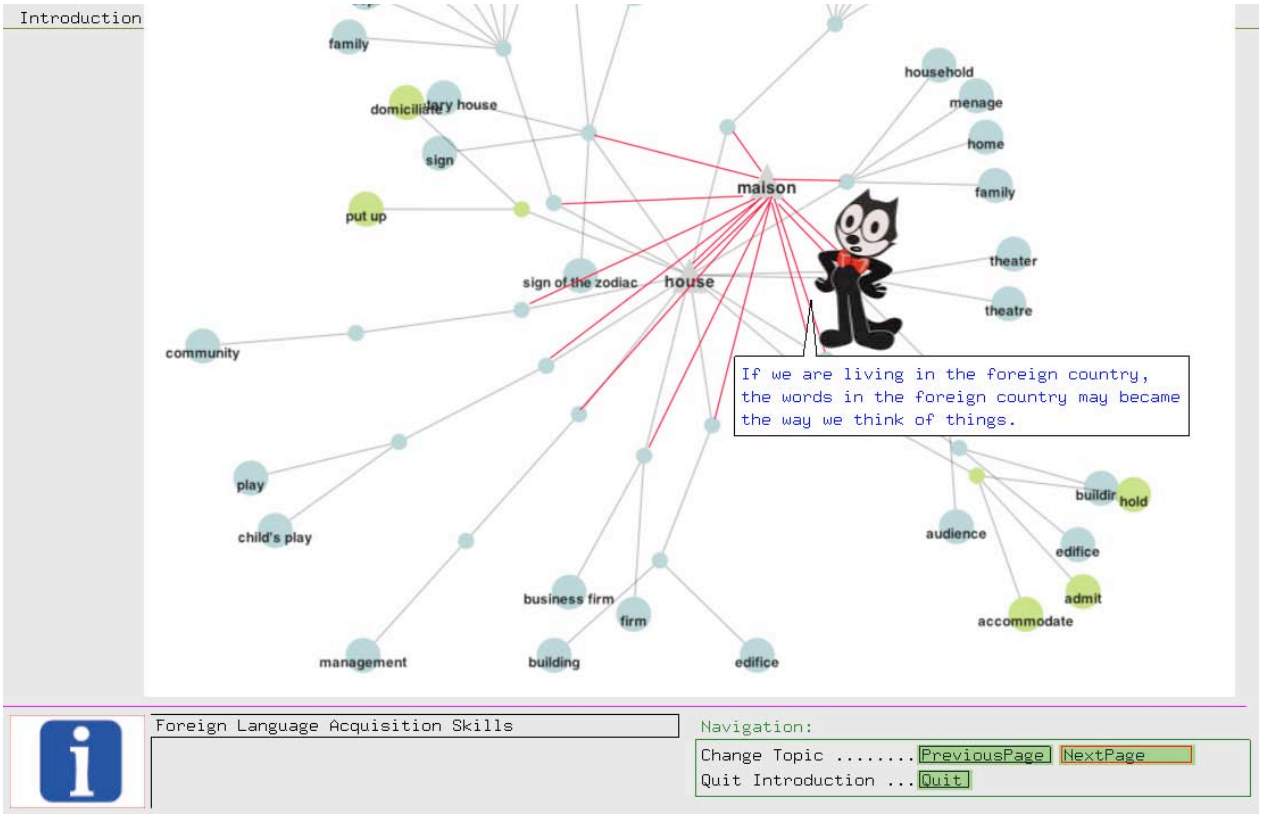
To allow a foreign word to represent an object is difficult, since the older we get the more relations to this object exist, and they are all connected to the native word. All the experiences we had with a particular object have built our understanding of that object.



To reprogram and accept all these connections to a foreign word cannot be done directly. The experiences we had will always be connected to this first native word assignment, since there was no other connection at that time. So, if we have to identify something, we will always get the describing words that have the most intense, - or what the brain thinks are the most relevant -, connections first: the words in our native language.



Thus, until this reprogramming has taken place, we have to use a bridge. However, the more intense we use the foreign word, the more associations and thus relevance this new foreign word will get.



If we are living in the foreign country, the words in the foreign language may become the way we think of things. And thus may become more relevance in our life than our native learned vocabulary. This situation is also known as: we start thinking in the foreign language.

For the pronunciation of words it is even more difficult to get it right, since the control of our vocal cord muscles have stopped to develop after we have mastered our native language. Or at least it is very hard to train your vocal cords without appropriate feedback that guides your efforts.

Therefore, it may seem nearly impossible to regain the ability to identify pitches, since the relative pitch characteristics, - that are present in all songs and musical activities -,will take precedence over absolute pitch detection skills.

Despite this argument, we know that we are capable of learning a foreign language. We also know that it takes many years of daily regular learning to acquire a foreign language. To perfect such a skill, we have to listen to native speakers, and actively use the language for quite some time.

Usually you cannot outrun a native speaker, - that has learned the language from day one on -, in respect of language understanding. However, the native language building is a lifelong, continuous process. In this way a foreigner that adopts a foreign language can outperform a native speaker that does not care about his language: for example does not care about spelling, correct grammar and expanding the vocabulary.

Learning Absolute Pitch like a foreign language

We think that absolute pitch can be learned like a foreign language.

The main barrier is: the needed time and effort versus the gained ability. For example, it would be nice to perfectly speak Chinese. But how many of us actually will start the year enduring process of learning Chinese? However, the motivation to learn Chinese is much stronger than the motivation to acquire absolute pitch. With Chinese you have the possibility to enter a new and lucrative, expanding market. Chances that you can profit from the language knowledge are much higher than if you learn the musical alphabet. Even if you stop the Chinese course after a year, you are still able to use your knowledge to some degree.

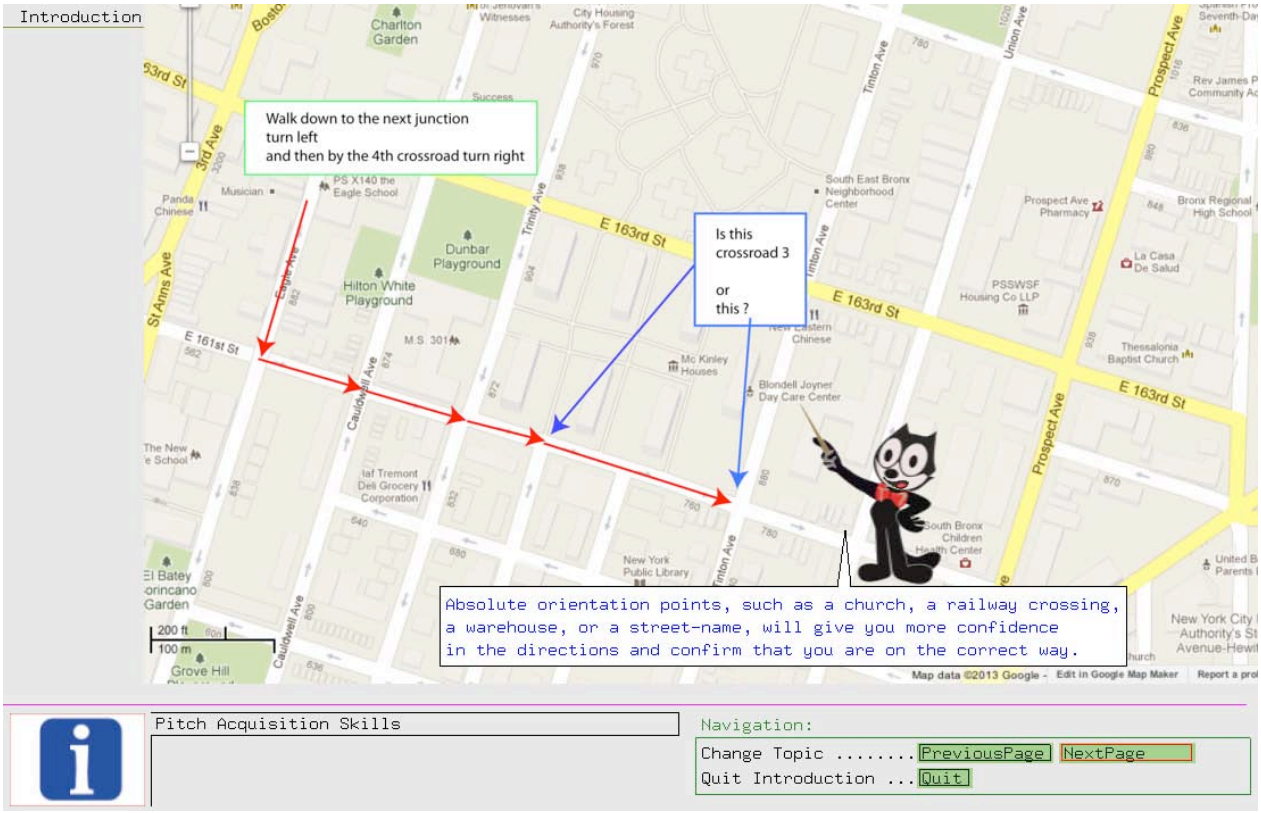
For absolute pitch this is only partially true you can go along with relative pitch quite well. Since there are basically only 12 notes that you have to recognize, your motivation will rapidly decrease, if you cannot see progress after a few days. So, people are spending 5, 10 yours of daily training to learn a foreign language, but nearly no-one will spend such an amount of time to acquire absolute pitch.

The main reasons why people continue to learn a foreign language are motivation for the goal, and seeing progress. Yes, your vocabulary and understanding of the foreign language growth notably over time.

Now for to learn absolute pitch, nothing looks in favor of the learning process: the uses for absolute pitch are rare, and seeing real proven progress is not easy. However, in the latter point we can help you: by tracking your progress.

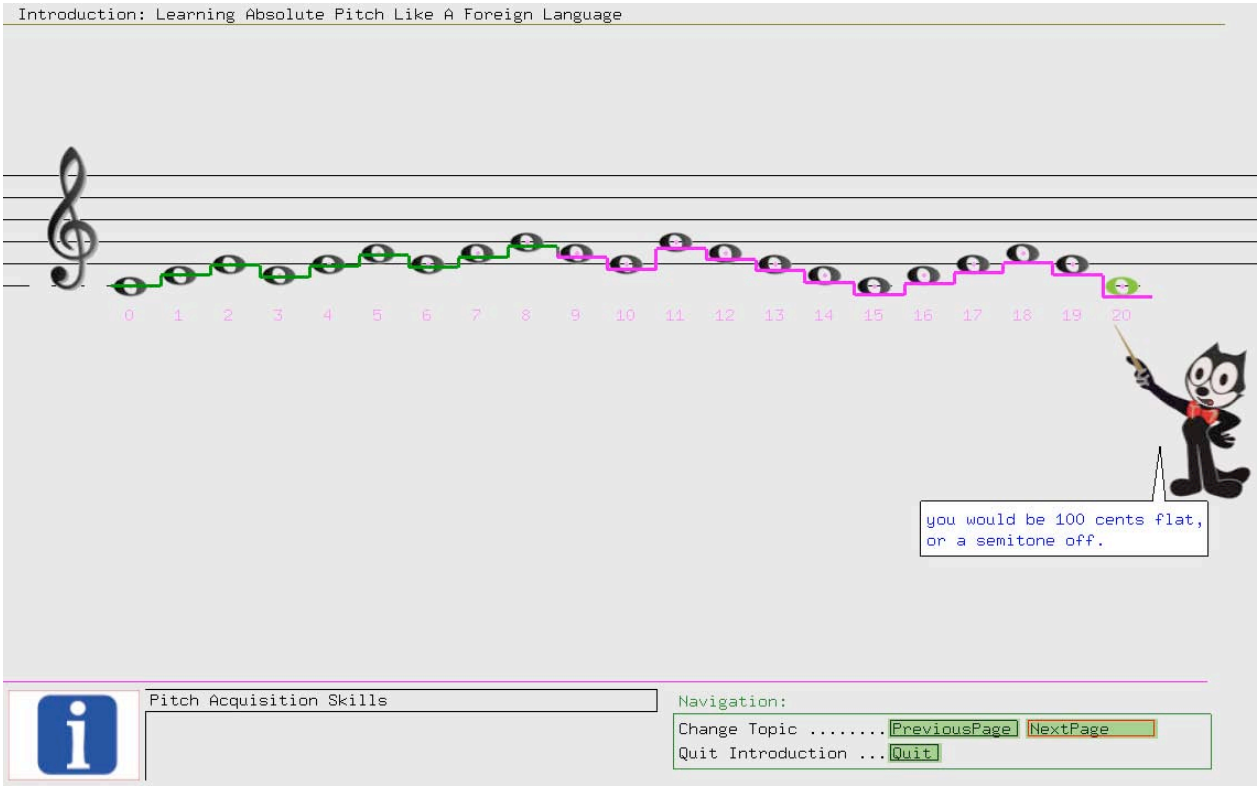
And for the first point, we see one reason to motivate you: orientation.

Let us compare musical orientation with locating a place.


Introduction
Walk down to the next junction
turn left
and then by the 4th crossroad turn right
Is this
crossroad 3
or
this ?
Absolute orientation points, such as a church, a railway crossing,
a warehouse, or a street-name, will give you more confidence
in the directions and confirm that you are on the correct way.
Pitch Acquisition Skills
Navigation:
Change Topic ..... PreviousPage NextPage
Quit Introduction ... Quit

For example, the relative instructions: after 4 crossroads turn right , might still get you into trouble, if the third crossroad turns out to be a very small intersection. Did the directions count it as a crossroad or not? Absolute orientation points, such as a church, a railway crossing, a warehouse, or a street-name will give you more confidence in the directions and confirm that indeed you are on the correct way.

In music absolute pitch means: you know where you stand. This is especially important for a cappella singing. Let us assume your relative pitch sense is always 5 cents flat.


Introduction: Learning Absolute Pitch Like A Foreign Language
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
you would be 100 cents flat,
or a semitone off.
Pitch Acquisition Skills
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Then, after 20 notes you would be 100 cents flat, or a semitone off. If you are not absolute pitch orientated, you would not realize that you are off a semitone. If you have absolute pitch to a precision of 20 cents, then after 5 notes you would realize your deviation from the correct pitch.

Fortunately, we seldom sing or play without an accompaniment, so most often we synchronize with the accompaniment, and avoid drifting off key. So orientation is not a compelling reason to acquire absolute pitch.

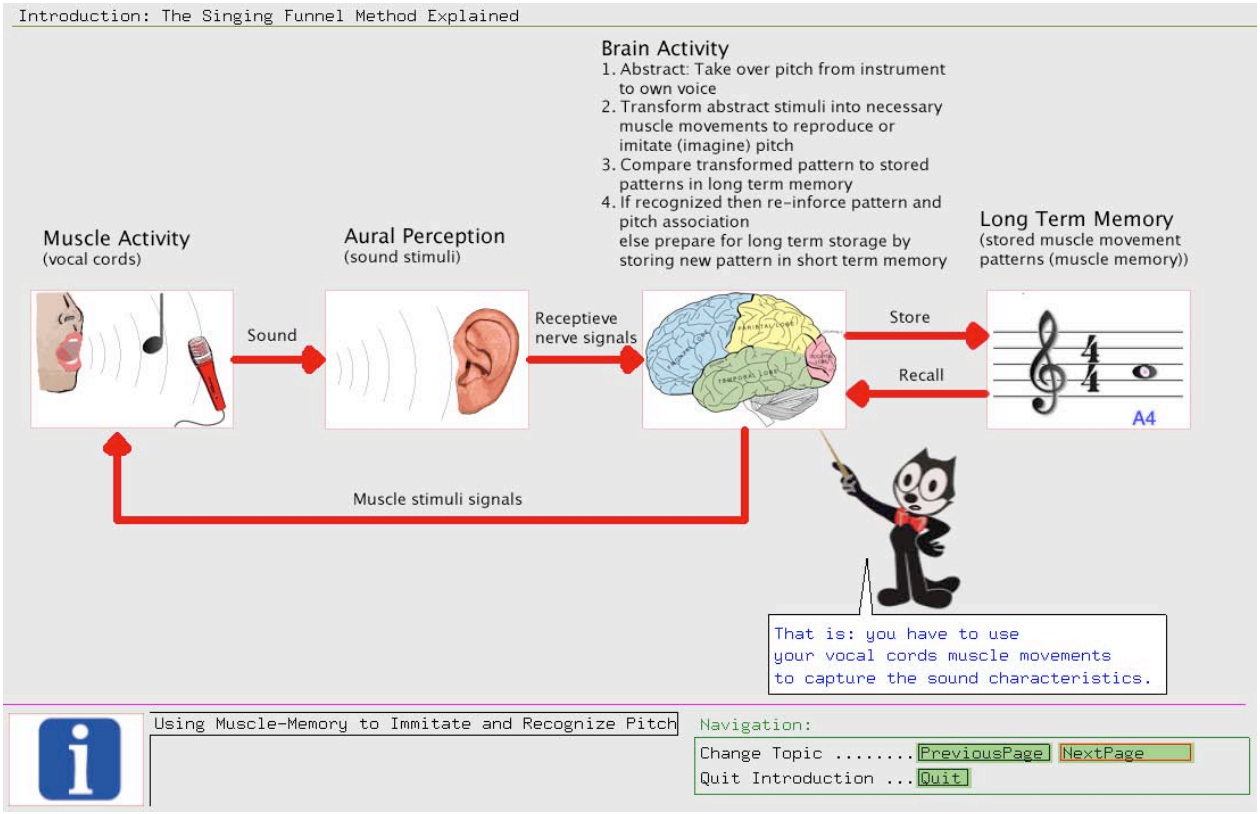
Improving your ears with our methods

A good ear is still one of the most important skills for every musician. Setting the acquisition of absolute pitch as a measurable goal for listening training is a possible way to go. However, the progress on this way should be visible and trackable. Tapping in the dark, and not seeing the light at the end of the tunnel is not funny. Therefore we have introduced the following three methods:

- The Singing Funnel Method
- The Octave Anchor Pitches Method
- The Interval Overtone Method

Inside the Singing Funnel Method

From the three methods, the Singing Funnel Method is the most important:


Introduction: The Singing Funnel Method Explained
Brain Activity
1. Abstract: Take over pitch from instrument to own voice
2. Transform abstract stimuli into necessary muscle movements to reproduce or imitate (imagine) pitch
3. Compare transformed pattern to stored patterns in long term memory
4. If recognized then re-inforce pattern and pitch association
else prepare for long term storage by storing new pattern in short term memory
Muscle Activity
(vocal cords)
Aural Perception
(sound stimuli)
Long Term Memory
(stored muscle movement patterns (muscle memory))
Sound
Receptieve nerve signals
Store
Recall
A4
Muscle stimuli signals
That is: you have to use your vocal cords muscle movements to capture the sound characteristics.
Using Muscle-Memory to Immitate and Recognize Pitch
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Quit Introduction ... Quit

We believe in a strong relationship:

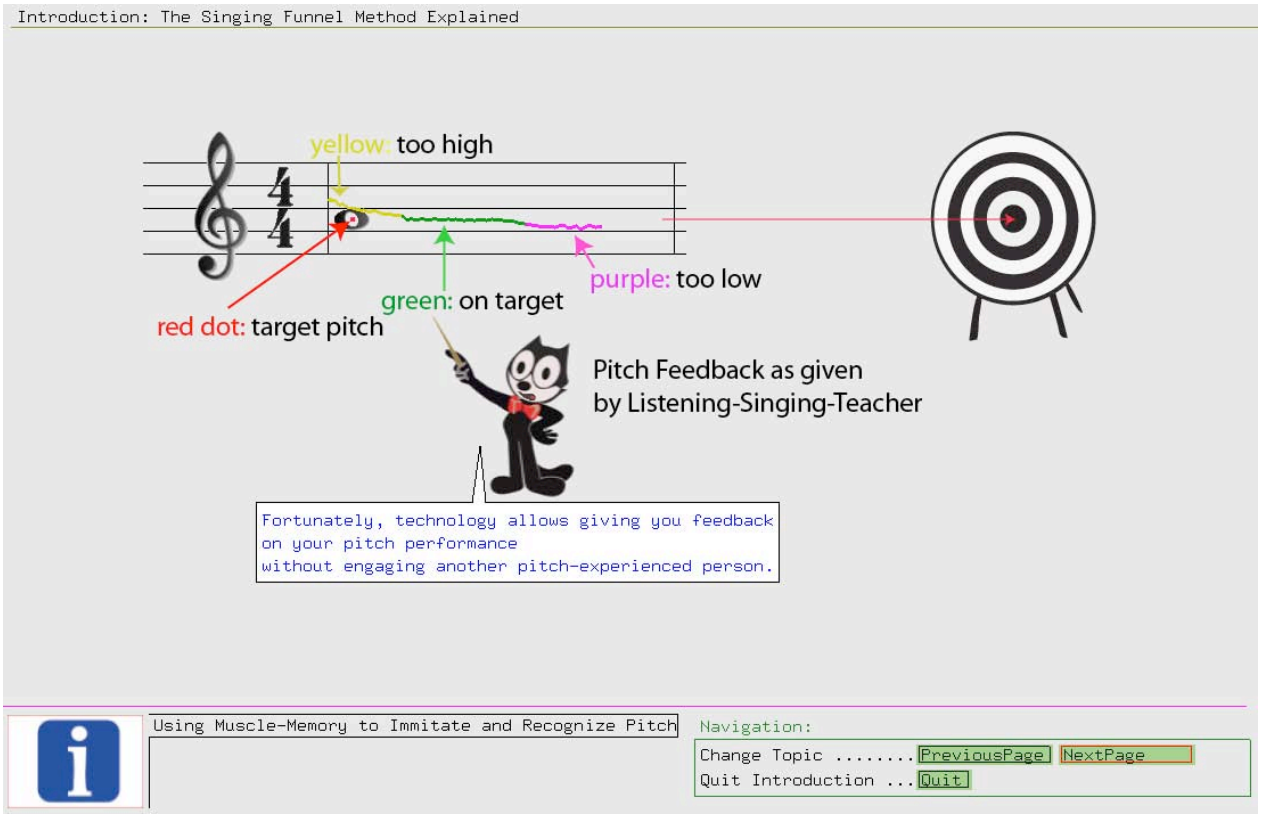
- between memory
- muscle activity
- and imitation

That is, we think that the brain is storing properties of events as retrievable muscle actions. We assume that these muscle movement patterns are stored in the long-term memory. This makes sense, because for a coordinated movement, we do not want to calculate muscle commands from abstract information. We just want to recall the necessary muscle commands. Maybe we want to change some parameters during the execution of the commands, but we still want to recall the movement commands as a procedure of simple timed movement commands.

Thus we store abstract muscle movement patterns that we think we can use again, in the long-term memory. To activate or compare these patterns we have to transform incoming information into the same pattern. A match of two patterns triggers a signal. So, when we want to activate a certain muscle pattern, our brain creates this pattern, and the match with the long-term memory triggers the "let the stored commands execute". To compare stimuli from the outside world, the stimuli have to be transformed by the brain to possible imitation events. For example transforming the heard pitch into muscle movement patterns to sing the pitch. If this simulated muscle movement patterns matches a stored pattern in the long-term memory, then the brain triggers the associations stored with this pattern. For example the name of the note. The reverse way, the imagination of the note name, will stimulate the necessary muscle movement activities to imitate the pitch. In this way, we can hear (with our "inner ear") the pitched sound.

In other words, the Singing Funnel Method uses the vocal cord muscle movements to capture sound characteristics.

Nevertheless, to learn something, - for example to make an association between a pitch and a note-name -, you need appropriate feedback.


Introduction: The Singing Funnel Method Explained
yellow: too high
purple: too low
green: on target
red dot: target pitch
Pitch Feedback as given
by Listening-Singing-Teacher
Fortunately, technology allows giving you feedback
on your pitch performance
without engaging another pitch-experienced person.
Using Muscle-Memory to Immitate and Recognize Pitch
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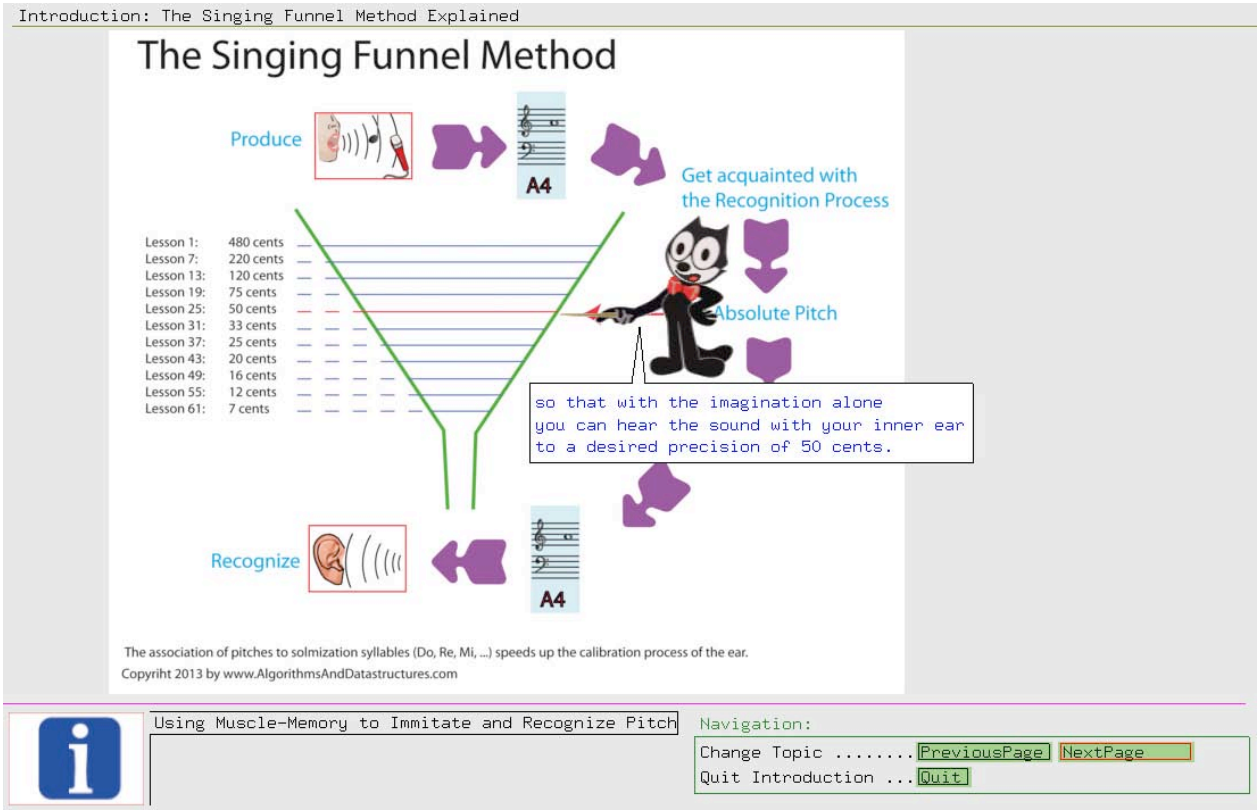
Fortunately, technology allows giving you feedback on your pitch performance without engaging another pitch-experienced person. In this way you can learn to control your vocal cord muscles free from inter-personal stress at your own pace.

This alone does not let you see the progress. Chances that you will fail to identify a sound correctly are way too high, and you will soon give up your goal. This is the point where our Singing Funnel Method comes to your help: the Funnel allows you in the beginning to score, even if you are more than 2 whole tones off.

Do not underestimate this first step. The points are not just given for free: you still have to concentrate on the sound production process. In addition the method starts with only two notes that you can choose at your own comfort. In this way you can gain confidence that you can pass the lesson without hassle. The method continues by expanding the number of notes to 3, 5, 8, 13 and finally to 18 notes. Since the allowed tolerance is still more than two whole tones, it should not be too difficult to pass the tests, even so it will get more difficult: you have to remember, how to produce the associated pitch for more notes. That is, your mind has to store and build distinct patterns for more different notes.

Once you have mastered this level, you start again with the first two notes. However, this time the allowed tolerance is narrower. In this way the task to remember, how to produce a certain pitch exactly, requires more attention. At the same time your listening skills will improve. That is: your ability to determine the deviation from the target pitch will increase.

Failures with the narrower tolerance will occur again. However, since we track your progress, you know that you could do it for a larger tolerance. Go back and verify that indeed you could make a progress that lasted. Maybe, you have to repeat the previous level again, but you will reach that last level again much faster. Therefore, you can say that at least partially the sounds did stick with you. Practice will ensure that you will fail less and less. Or in other words, you can produce and therefore recognize the pitches to ever better accuracy levels.


Introduction: The Singing Funnel Method Explained
The Singing Funnel Method
Produce
A4
Get acquainted with
the Recognition Process
Lesson 1: 480 cents
Lesson 7: 220 cents
Lesson 13: 120 cents
Lesson 19: 75 cents
Lesson 25: 50 cents
Lesson 31: 33 cents
Lesson 37: 25 cents
Lesson 43: 20 cents
Lesson 49: 16 cents
Lesson 55: 12 cents
Lesson 61: 7 cents
Absolute Pitch
so that with the imagination alone
you can hear the sound with your inner ear
to a desired precision of 50 cents.
Recognize
A4
The association of pitches to solmization syllables (Do, Re, Mi, ...) speeds up the calibration process of the ear.
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Using Muscle-Memory to Immitate and Recognize Pitch
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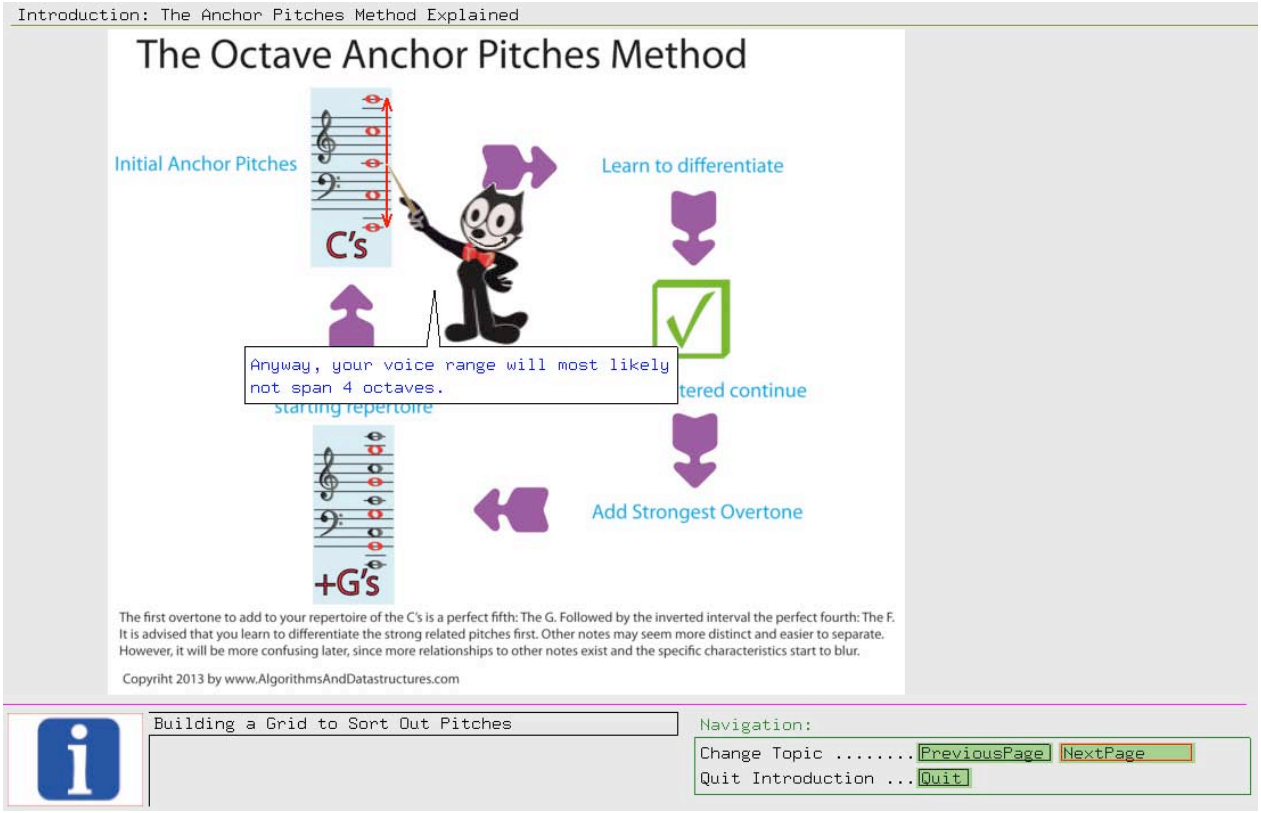
However, depending on your musical background it may still take a year, or more, of daily training, until you have enough fine control of your vocal cord muscles, so that with the imagination alone you can hear the sound with your inner ear to a desired precision of 50 cents.

Disappointed about the time frame needed? Remember to learn a foreign language, - depending on your age and other language experience -, may take even longer to acquire a basic language certificate.

To accelerate the learning process, we suggest that you use the Octave Anchor Pitches method at the same time.

Inside the Octave Anchor Pitches Method

The Octave Anchor Pitches method supports the Singing Funnel method in the way that it will help you to orientate yourself better in the pitch realm.


Introduction: The Anchor Pitches Method Explained
The Octave Anchor Pitches Method
Initial Anchor Pitches
C's
Learn to differentiate
Anyway, your voice range will most likely not span 4 octaves.
tered continue
Add Strongest Overtone
+G's
The first overtone to add to your repertoire of the C's is a perfect fifth: The G. Followed by the inverted interval the perfect fourth: The F. It is advised that you learn to differentiate the strong related pitches first. Other notes may seem more distinct and easier to separate. However, it will be more confusing later, since more relationships to other notes exist and the specific characteristics start to blur.
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Building a Grid to Sort Out Pitches
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Anyway, your voice range will most likely not span 4 octaves. So you need another method to learn to recognize the pitches outside your voice range. As the name implies in this method the characteristics of a particular note is presented in all octaves.

First you learn to distinguish the Cs by the octave. Since there are only five notes, C2, C3, C4, C5 and C6, it should be fairly easy to distinguish the notes. Thus giving you anchor pitches that are an octave apart.

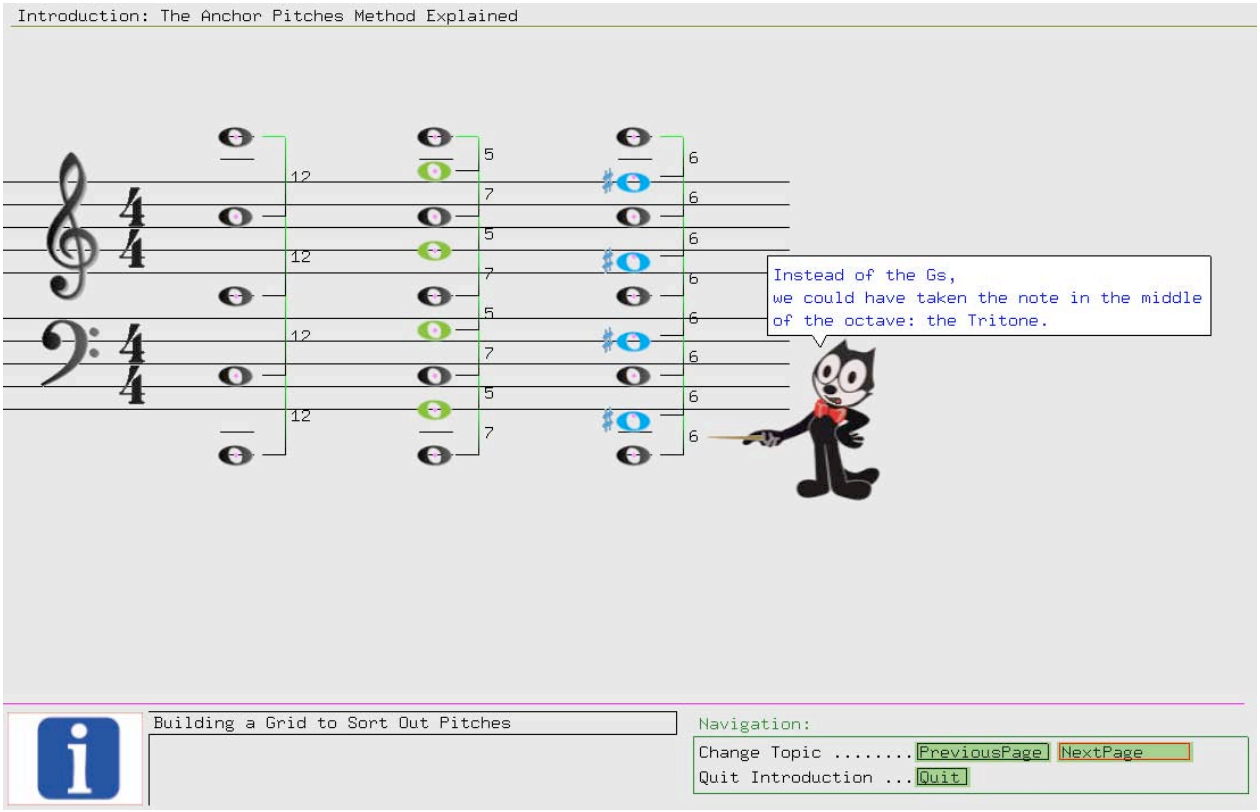
Despite the impression that this is easy, you should not advance to the next lesson until you are sure that you can identify theses five notes without relative pitch skills. That is you should not continue immediately with the next lesson on the same day. Instead you should repeat the lesson the next day, and only continue if you are successful. Better yet, before you continue to the next lesson, wait until you can identify the five notes seven days in a row. It is more important that you learn to differentiate the octaves and to get acquainted with the C characteristic than to progress fast.

The method will add new notes very slowly by adding just one other category of sounds to the already learned sounds. You are advised to learn to recognize these old and new notes in this limited context, until you can assign the pitches thoroughly to the corresponding notes.

When you are able to distinguish all Cs, the method continues with all Gs. In the exercise setting you will easily recognize when a note with a different characteristic, - the G characteristic -, is played, since it will sound differently from the already learned Cs, Since you can rely on that the new (unrecognizable) notes in the exercise will be Gs, it should not be too complicated to assign the G to the appropriate octave.

Especially, since you already have built an anchor grid with the Cs.

If we look at the distances between the notes in half steps, we see that the Cs are 12 half steps apart.


Introduction: The Anchor Pitches Method Explained
Instead of the Gs,
we could have taken the note in the middle
of the octave: the Tritone.
Building a Grid to Sort Out Pitches
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By adding the Gs, the distances to distinguish the pitches decreases to 7, respectively to 5. half steps. Instead of the Gs, we could have taken the note in the middle of the octave: the Tritone.

The Tritone sound would be easier to distinguish from the Cs than the Gs from the Cs, since the Tritone sound has less in common with the Cs than the Gs. However, we have our reasons why we proceed this way. An explanation for our proposed course of action will be given in the chapter “Inside the Interval Overtone method”.

Again, you have to learn the Gs until you can differentiate and assign the Cs and Gs to 100 %. To be successful with the exclusion method you are forced to deal intensively with the already learned notes and the new notes.

When you are ready for the next step the method continues by adding the next strong overtones: the Fs.

Now there are 13 notes to choose from and you will have to listen more carefully to distinguish the notes. But you will see that it is still achievable, because you are in this special setting. If you make too many errors, you may need to go back again to the previous level with less notes to refresh the already learned pitches.

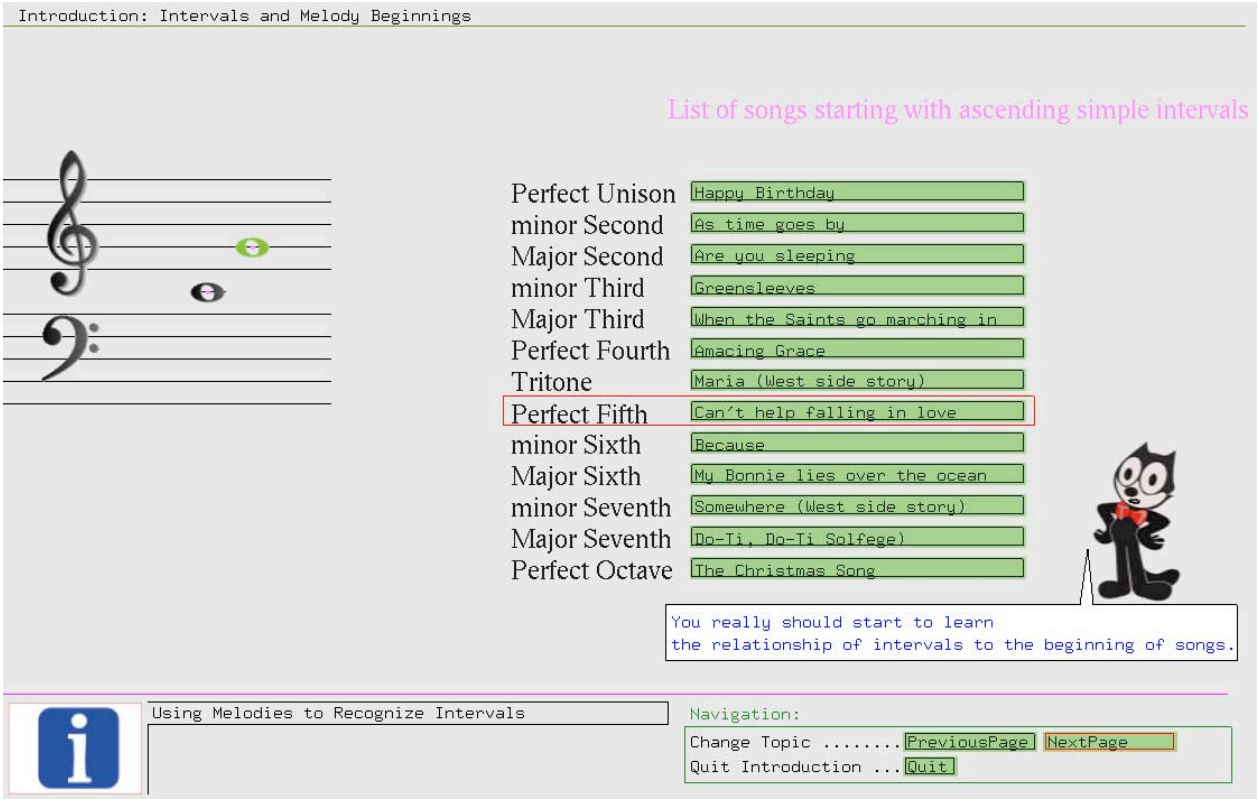
Now, if you think that it is not worth the effort, since you never will find yourself in such a special setting, trust us: if you can distinguish the notes in this special exercise settings, you will be proud that you can observe the progress, - note by note. To generalize the skill to other instruments can be done later.

The important point is: you can track your progress. You will also realize that the process how to learn to differentiate pitches itself, is what you really needed to get going on the pitch recognition path.

Inside the Interval Overtone Method

The Interval Overtone method contains exercises to improve your relative pitch sense.

An effective way to learn to recognize relative distances of pitches is: to have reference songs that start with the 13 possible simple intervals.



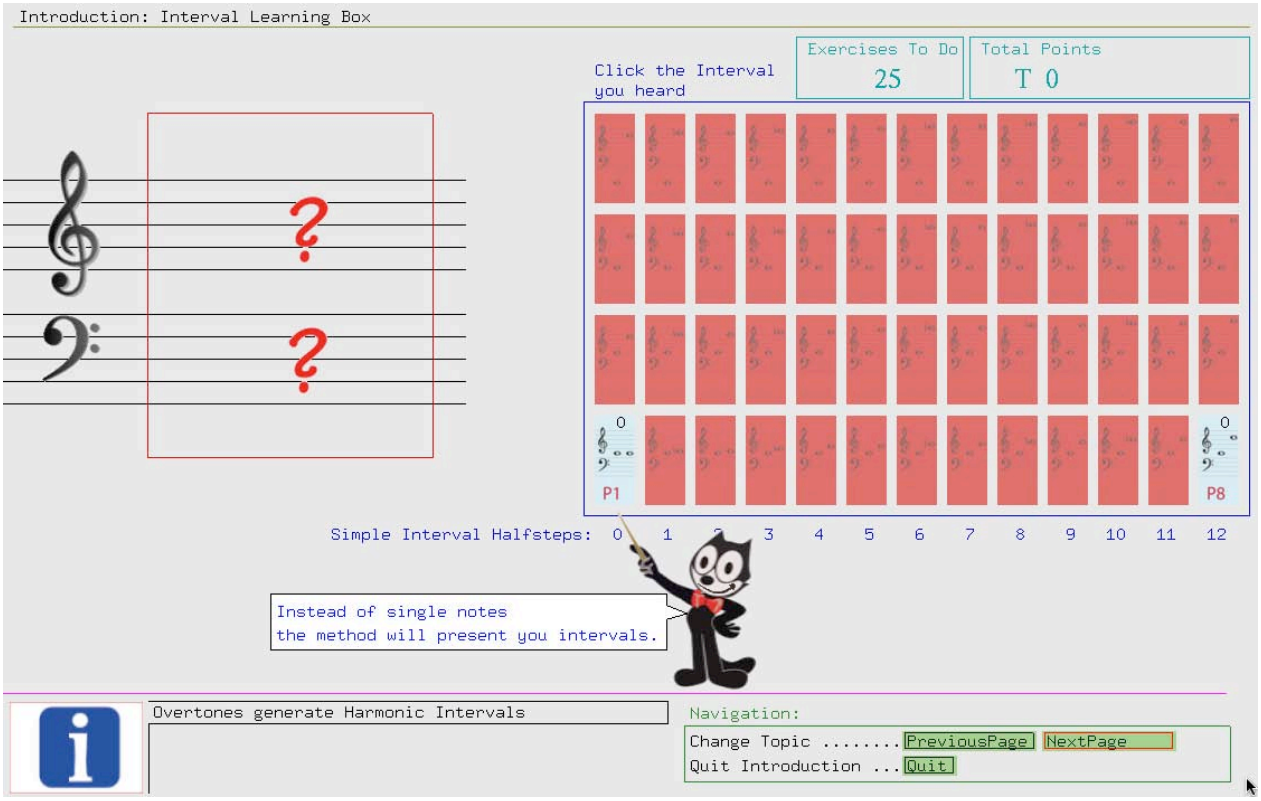
Since songs have an overwhelming set of information (e. g. lyrics, rhythm, melody, etc.), it is easy to remember them. This allows us to go back to the beginning of a song and hear an example of an interval with our inner ear.

We believe in learning by doing and easier memorizing by doing. To recognize something, you must first have a reference in your mind. Therefore it is important that you can build a retrievable association for each interval. Unfortunately, the human voice is not constructed to utter two pitches at the same time. So the only activity we can do, to memorize the sound of an interval is to sing or hum one note after the other.

Once we can recognize ascending intervals fairly well and fast, for different starting notes, we can melt the two starting sounds into one harmonic interval.

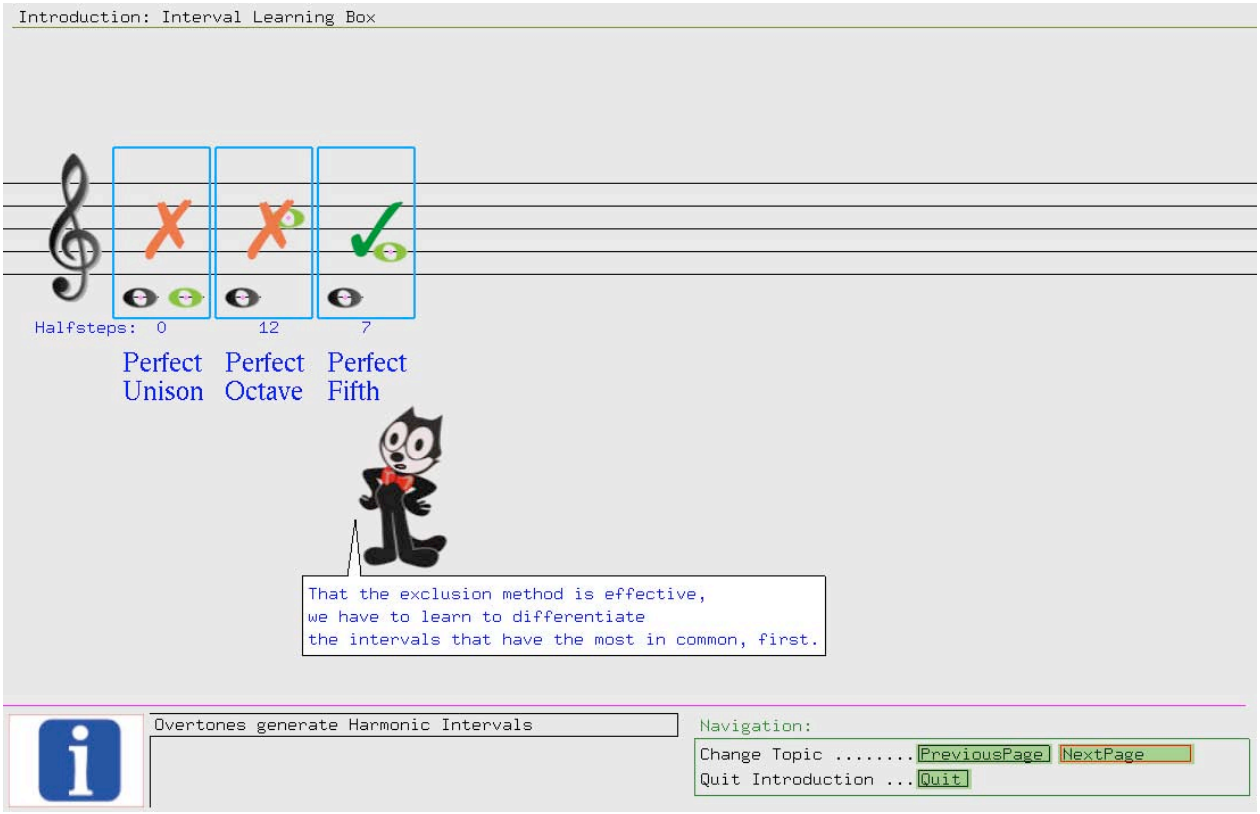
It is the harmonic interval characteristic that we want to learn to recognize. The interval listening skill is: being able to hear the frequency ratio of two pitches. This frequency ratio makes up the characteristic sound of an interval. This frequency ratio stays the same for a particular interval, independent of the absolute pitches of the involved notes.

Again we use a learning box to learn to listen for specific interval characteristics.



As with the single note s recognition process, we start with a simple repertoire of only two interval characteristics: the Octave and the Unison. The fact that the Unison sounds just like one sound and not two different notes makes it easy to differentiate the intervals.

The method builds on adding new intervals to already known intervals. To recognize a new interval characteristic, we use the approach by exclusion. That is we recognize an added, new interval characteristic by learning to differentiate the new interval characteristic from the already known ones.


Introduction: Interval Learning Box
Halfsteps: 0 12 7
Perfect Unison
Perfect Octave
Perfect Fifth
That the exclusion method is effective,
we have to learn to differentiate
the intervals that have the most in common, first.
Overtones generate Harmonic Intervals
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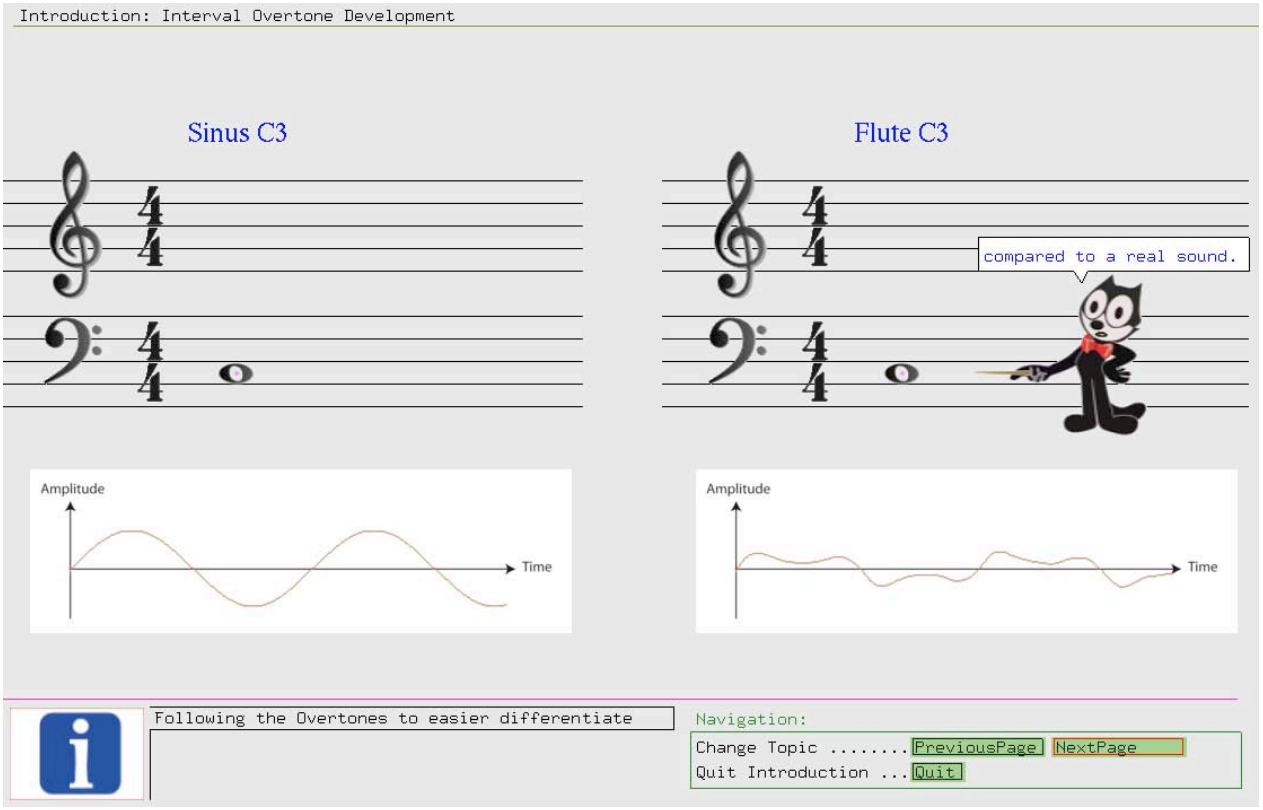
That the exclusion method is effective, we have to learn to differentiate the intervals that have the most in common, first. That is, because interval characteristics that share a lot in common are the most difficult to differentiate, we want to learn the characteristics in the succession of their similarity.

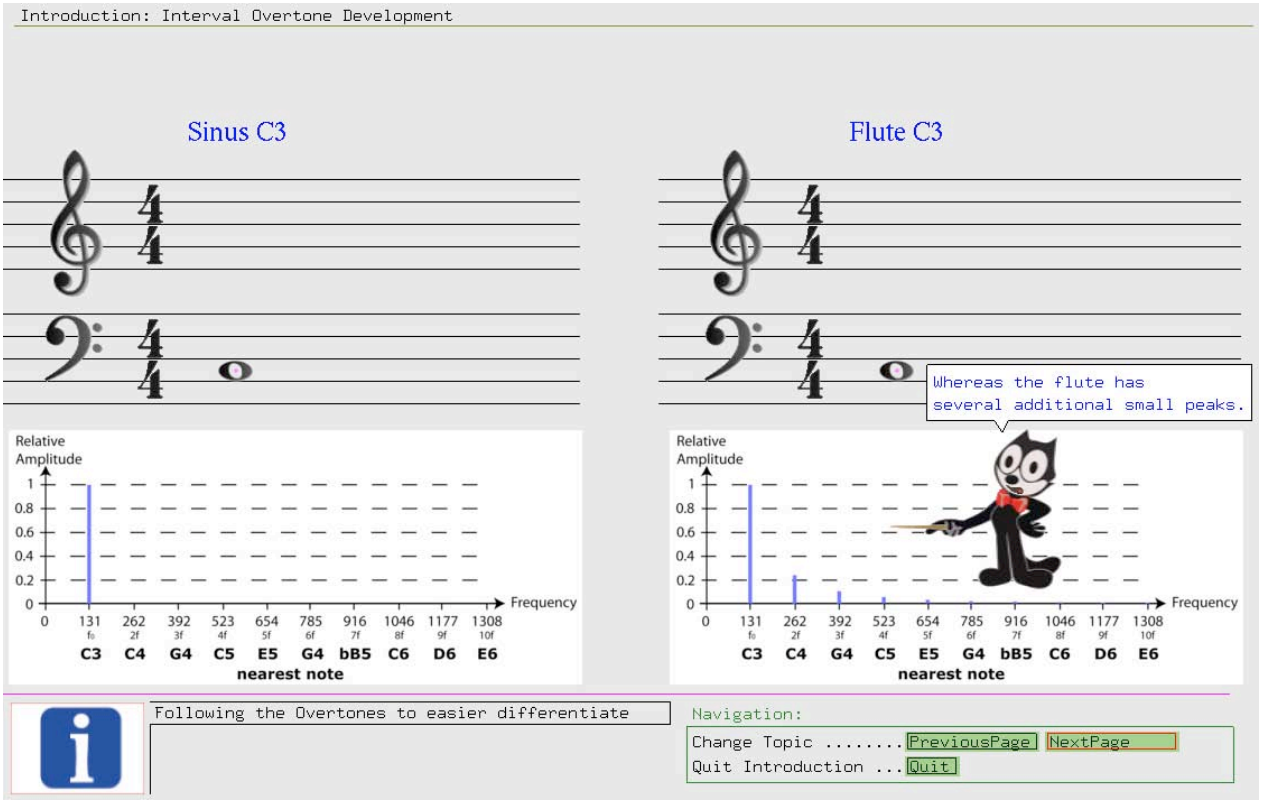
Now, what do we mean by most in common?

The interval overtone development

Every natural sound has overtones. A pure pitch is a sinus wave. Compared to a real sound, the sinus wave sounds very dull.



If we look in the frequency domain, the spectrograms look like this:



The pure sound has only one sharp peak at 131 Hz- whereas the flute has several additional small peaks. These peaks represent higher frequency pitches that are called: overtones.

Since real instruments produce overtones, we can build intervals between any two overtones an instrument produces.

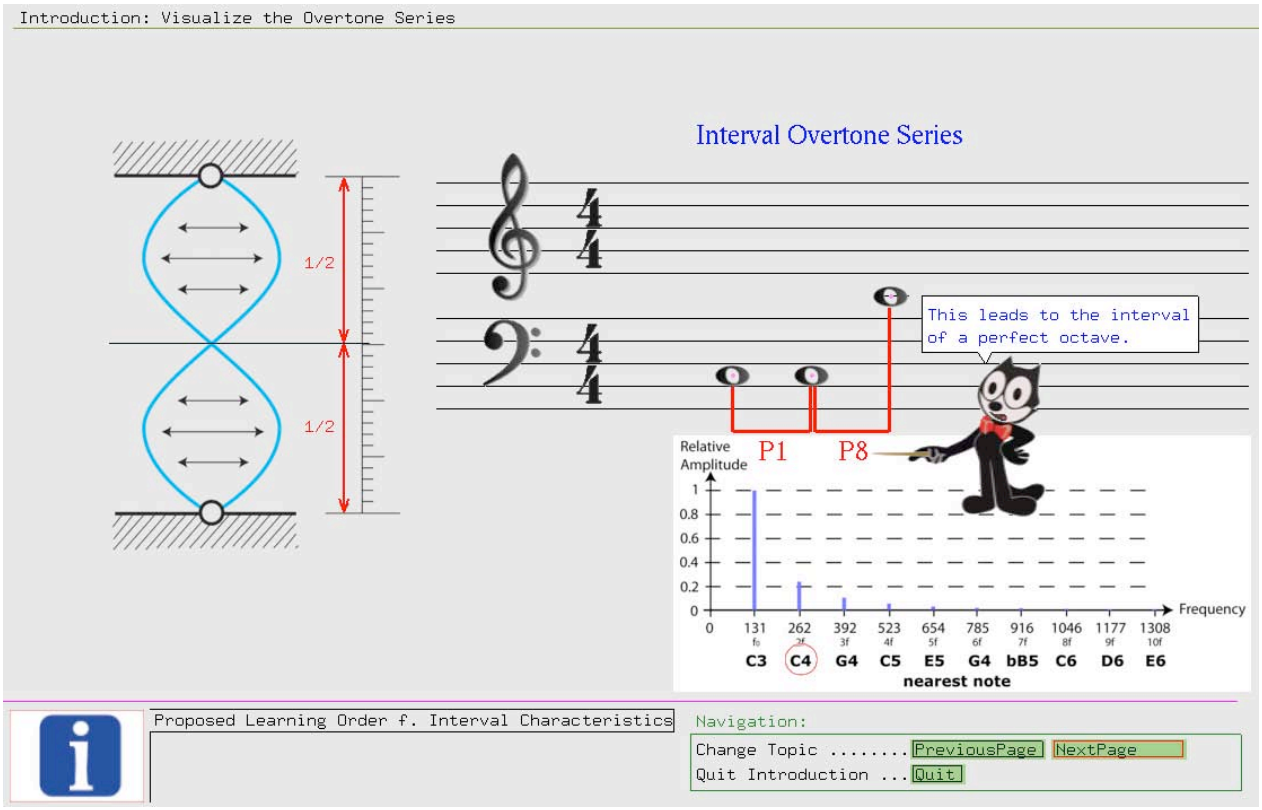
Since the intensity of the overtones decline with the overtone-number, the order in which the overtone occur is important for the hearing experience. With each overtone a new interval characteristic is revealed.

Let us go through the occurrence order of overtones, and their inherent harmonic intervals.

To visualize the overtone series let us look at a string that vibrates with 131 Hz: the note C3.

First we have the fundamental tone with no overtones. With only one tone, you can build only Unisons.

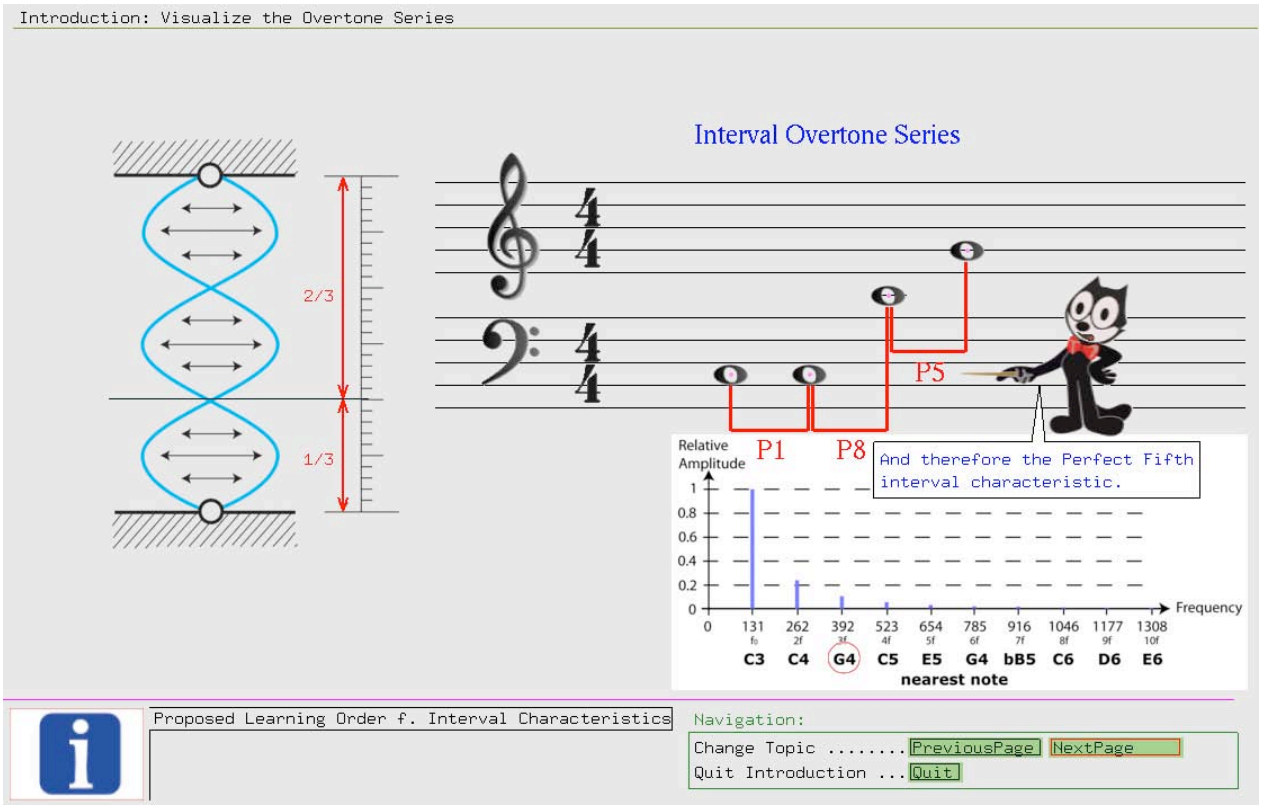
Physically the most simple wave-length change is: to half the wave-length. Since a string has the freedom of form, the original string can also swing with this shorter wave-length. Thus producing the first overtone: the note C4.



Since the overtone sounds at the same time as the fundamental, a harmonic interval of a Perfect Octave can be heard.

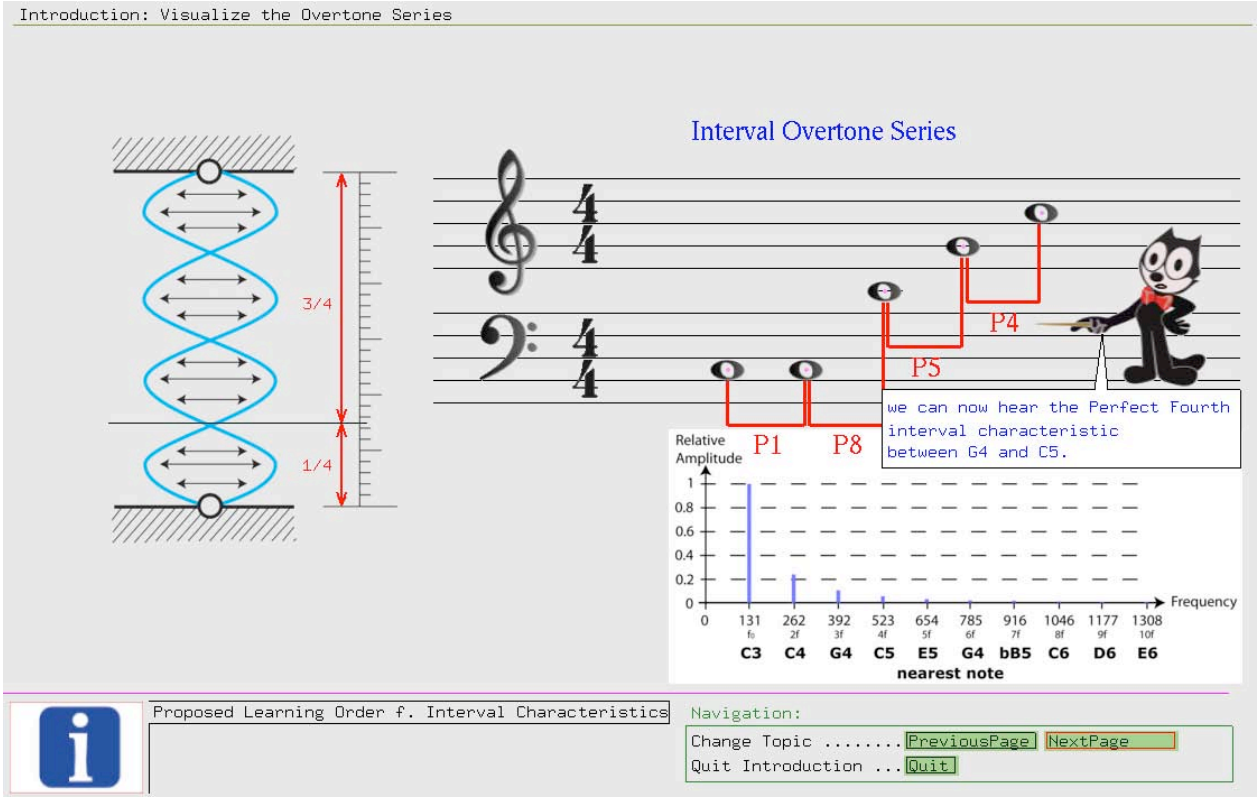
That means, almost every sound will have, - as a strong overtone -, an octave of its fundamental pitch in it. Therefore with every pitched sound, we will also hear the octave interval characteristic.

The next simple wave-length change is to divide the wave-length into three parts. This shorter string swings at triple the speed of the original, and corresponds to the note G4.



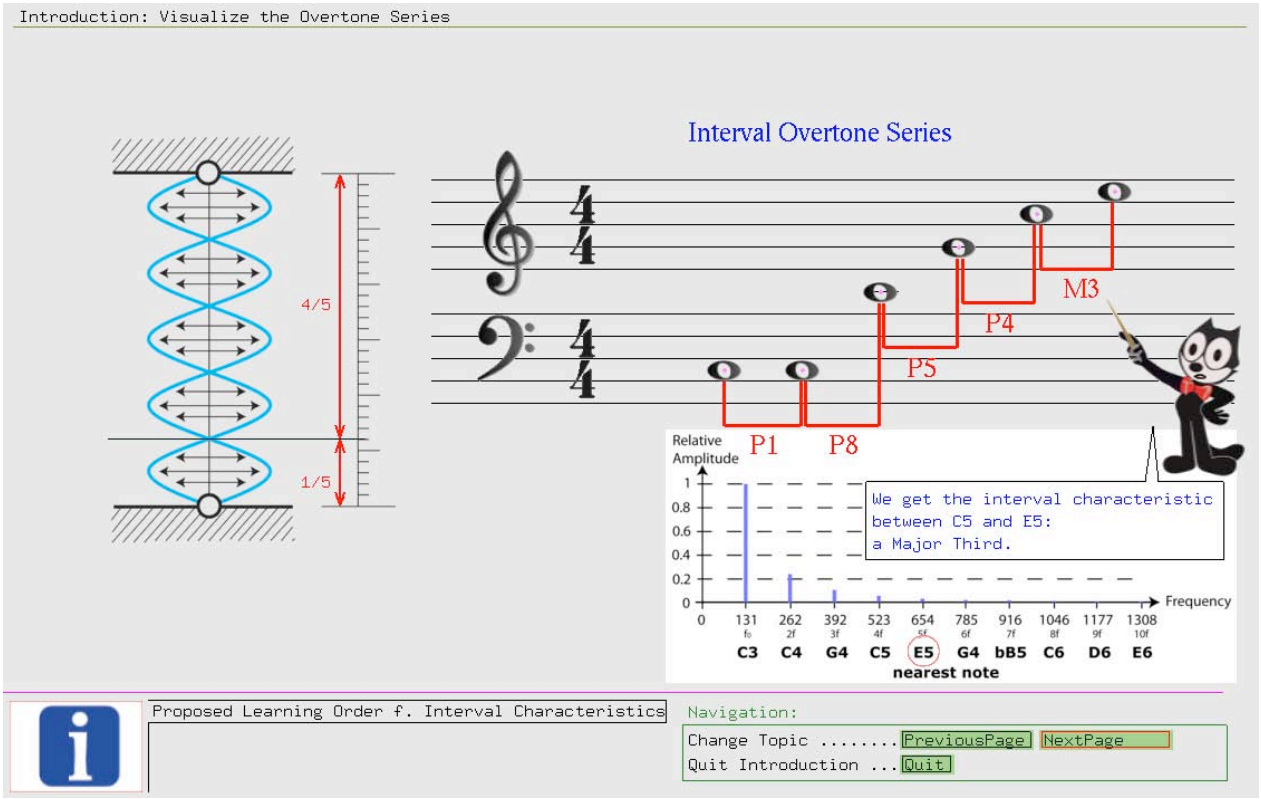
So the next overtone every sound will have, in addition to the octave, is the Perfect Fifth. And therefore the Perfect Fifth interval characteristic.

By dividing the fundamental wave-length by four, we get an octave of the octave, the note C5.which is not really of interest.

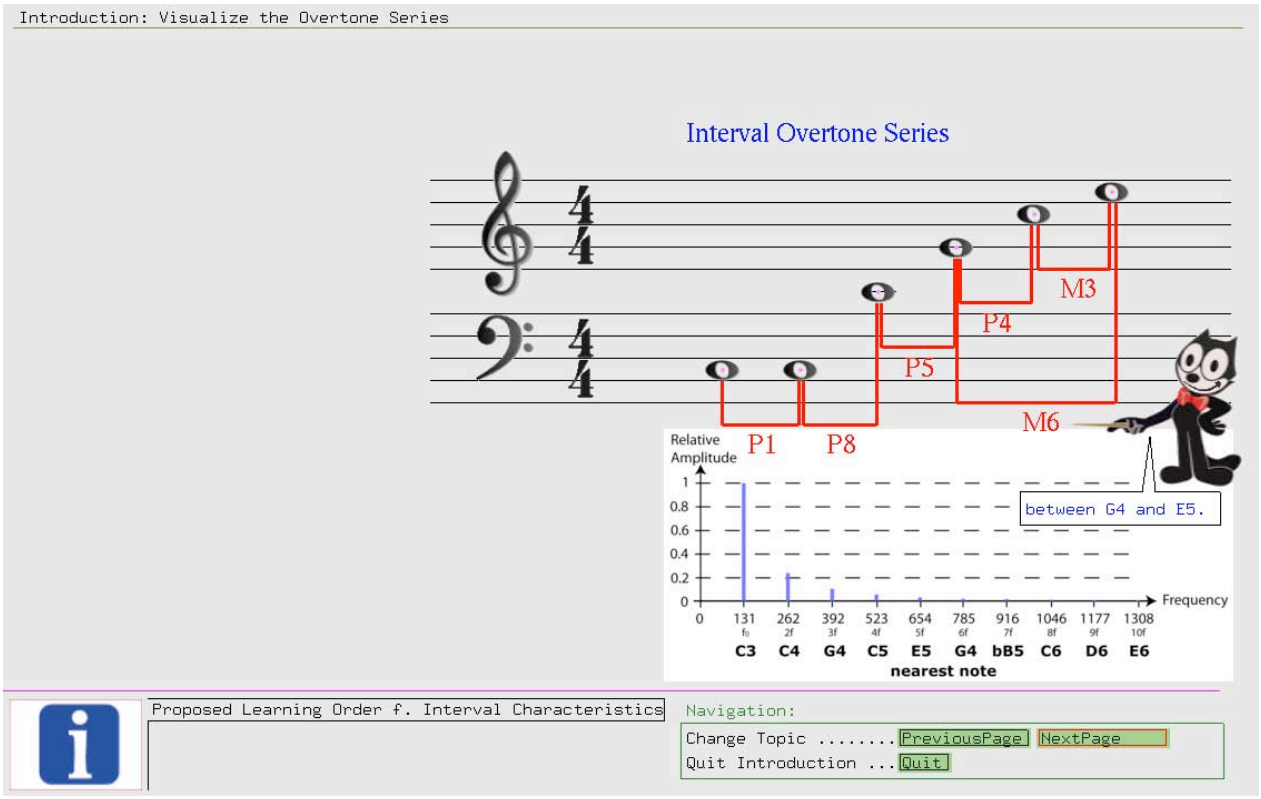


However since the G4 already exists as an overtone, we can now hear the Perfect Fourth interval characteristic between G4 and C5.

By dividing the fundamental wave-length by five, we get the interval characteristic between C5 and E5: a Major Third.

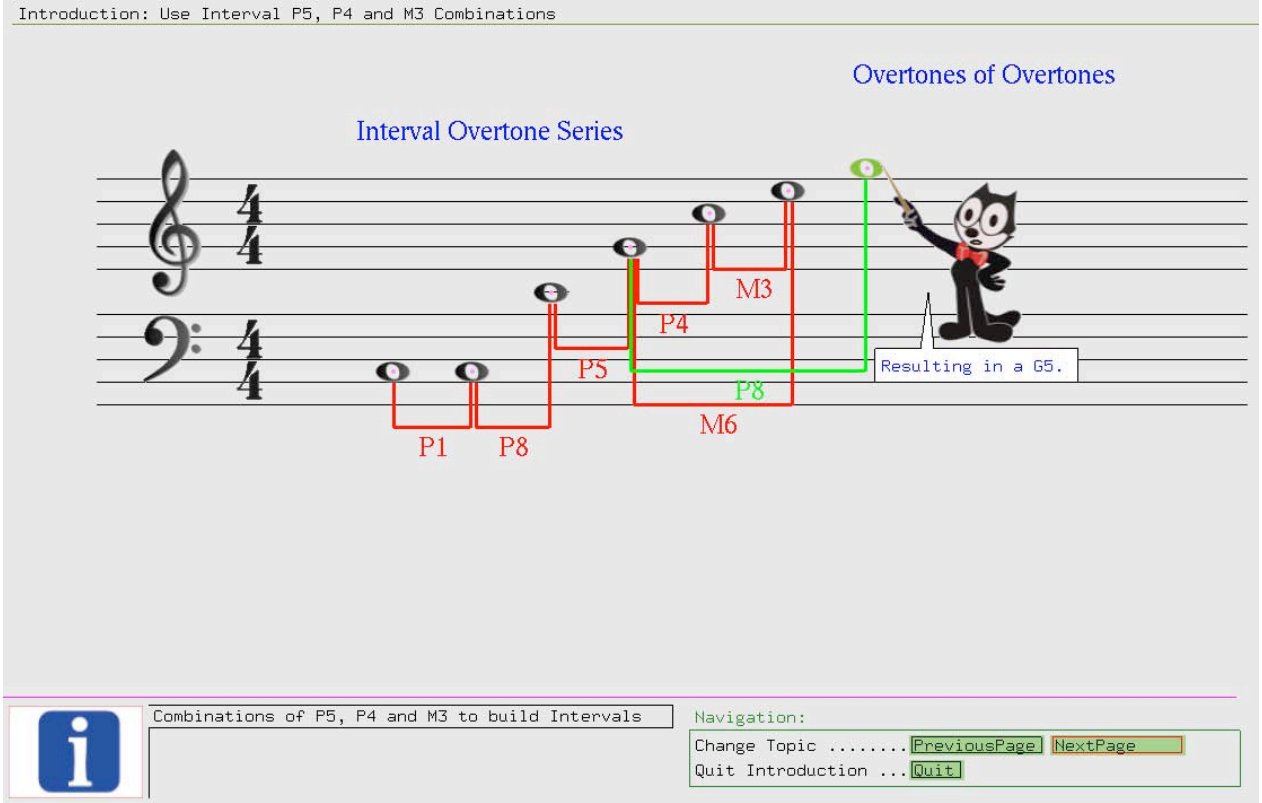


If we take a closer look at our interval overtone series, we see that we also can hear the interval of a Major Sixth, between G4 and E5..

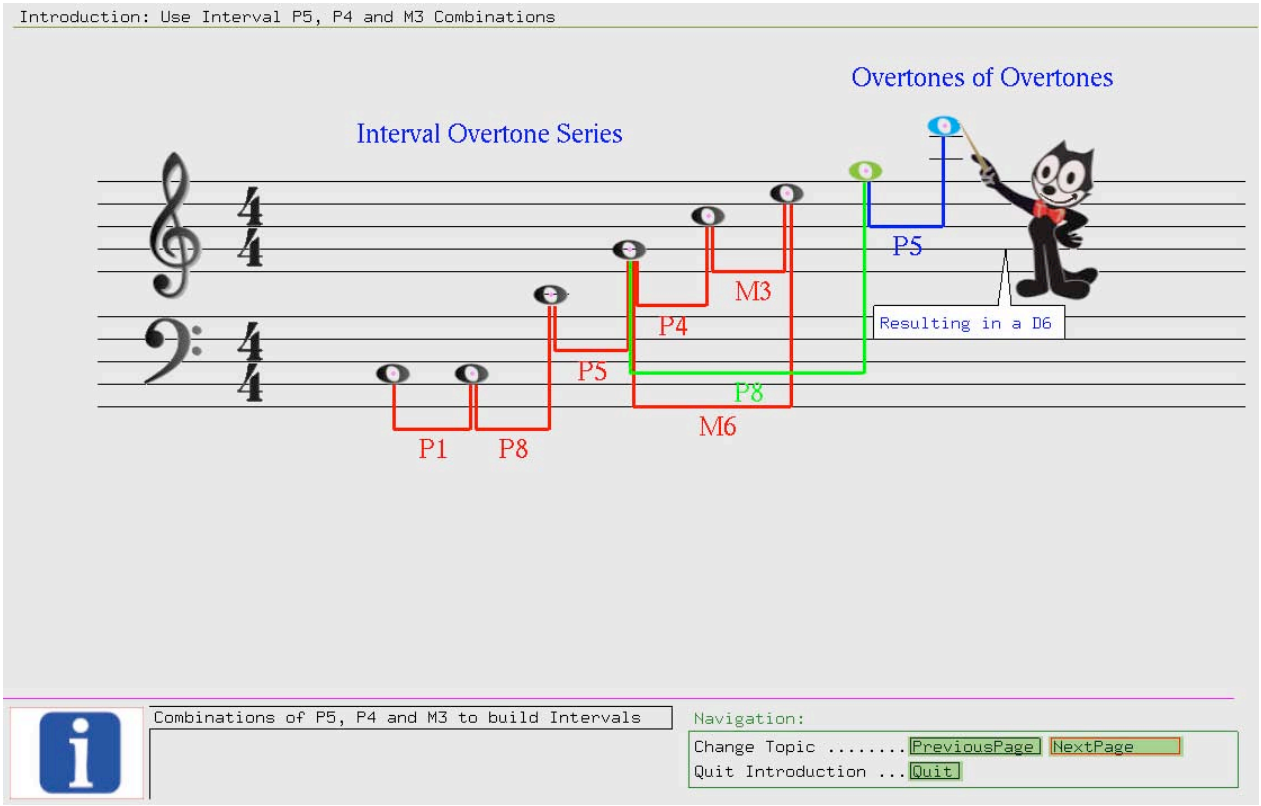


Now we think that the next forthcoming overtones are already so weak, that combinations of already revealed intervals are more important, than the intervals that are revealed with the next very weak overtones. Don't forget that an overtone also has its own overtones. These overtone swingings support each other, since they fall into natural wave-length divisions.

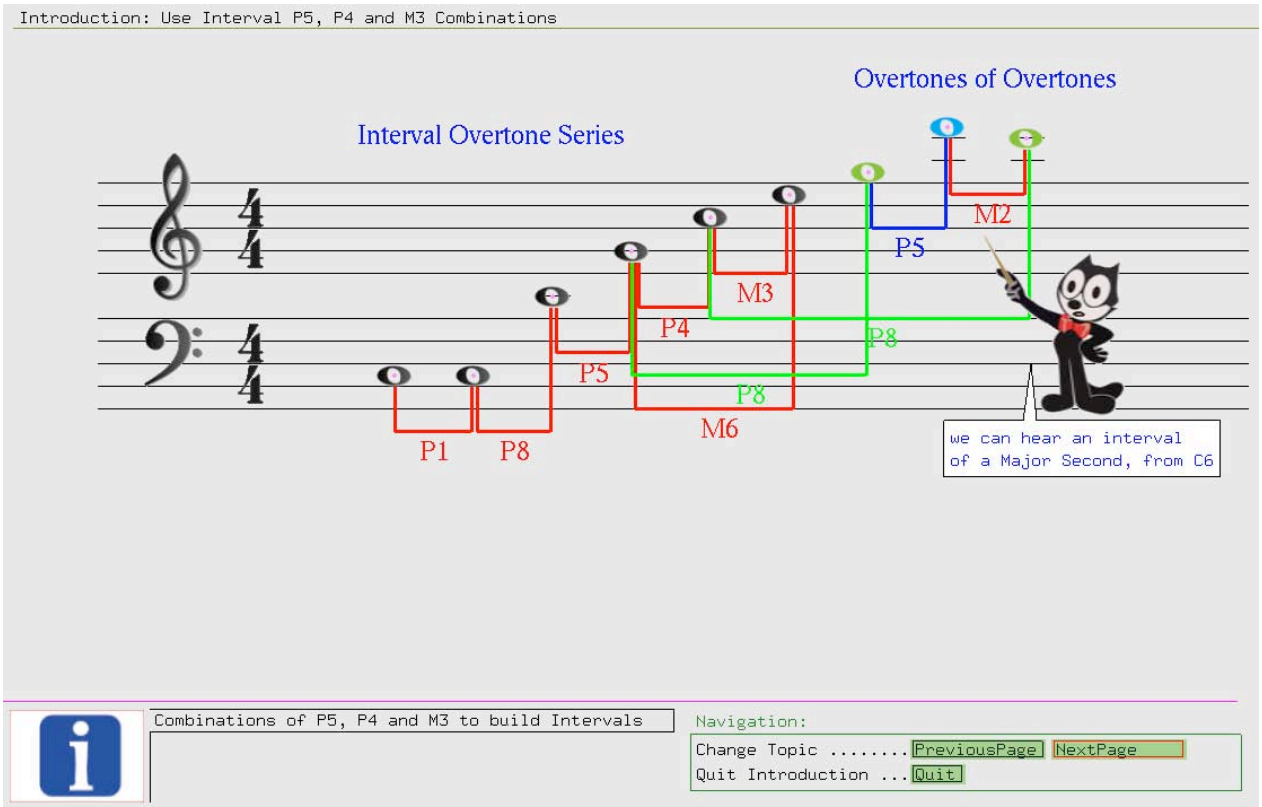
For example, the first Perfect Fifth produced, the G4, has itself an overtone of an octave: resulting in a G5.



But the first Perfect Fifth produces also a Perfect Fifth as the second overtone of its own tone. Resulting in a D6.

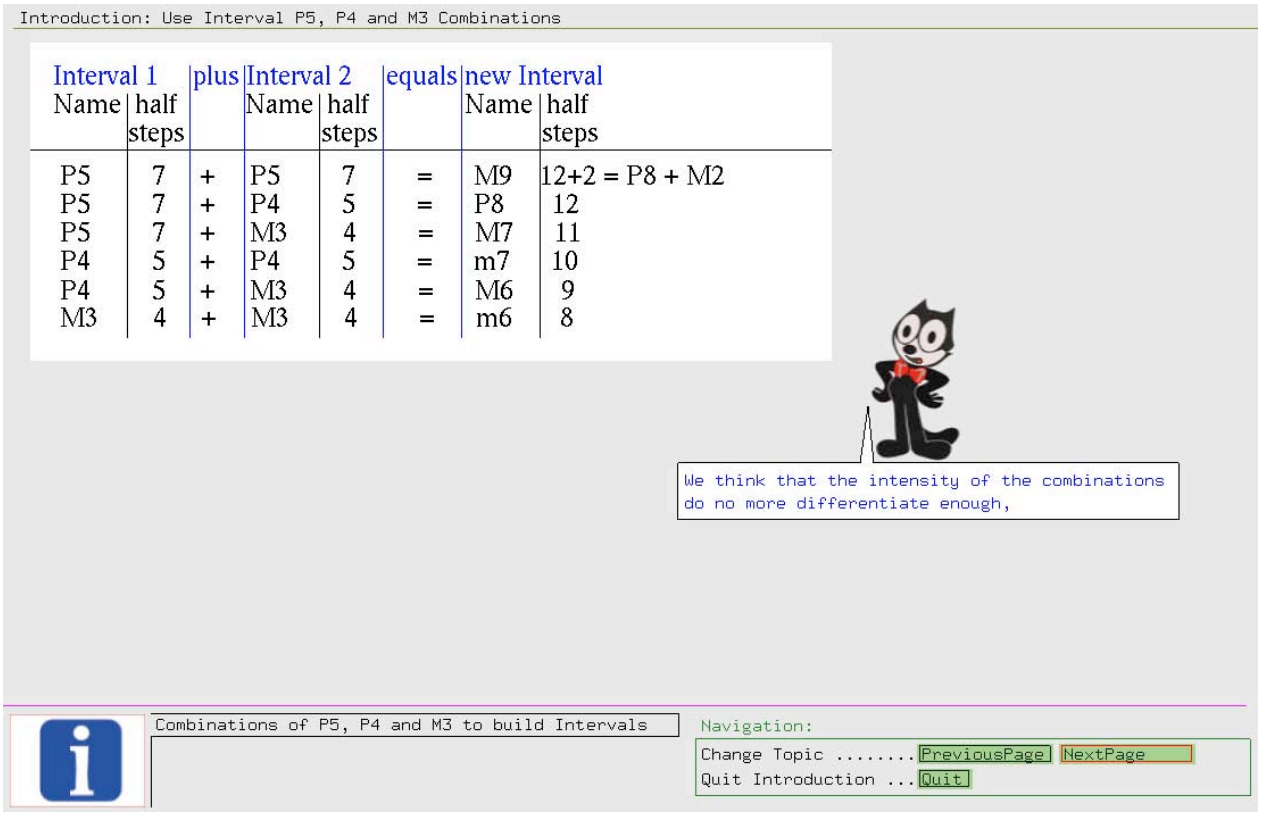


Since the note C5 has a C6 as its first overtone, we can hear an interval of a Major Second, from C6 to D6.



Thus we can hear a Major Second without going further in the overtone series than two overtones. That is, we can construct a Major Second solely from Octaves and Perfect Fifths.

So let us look at possible additive combinations of P5, P4 and M3:


Introduction: Use Interval P5, P4 and M3 Combinations
Interval 1 Name | half steps
plus
Interval 2 Name | half steps
equals
new Interval Name | half steps
P5 7 + P5 7 = M9 12+2 = P8 + M2
P5 7 + P4 5 = P8 12
P5 7 + M3 4 = M7 11
P4 5 + P4 5 = m7 10
P4 5 + M3 4 = M6 9
M3 4 + M3 4 = m6 8
We think that the intensity of the combinations do no more differentiate enough,
Combinations of P5, P4 and M3 to build Intervals
Navigation:
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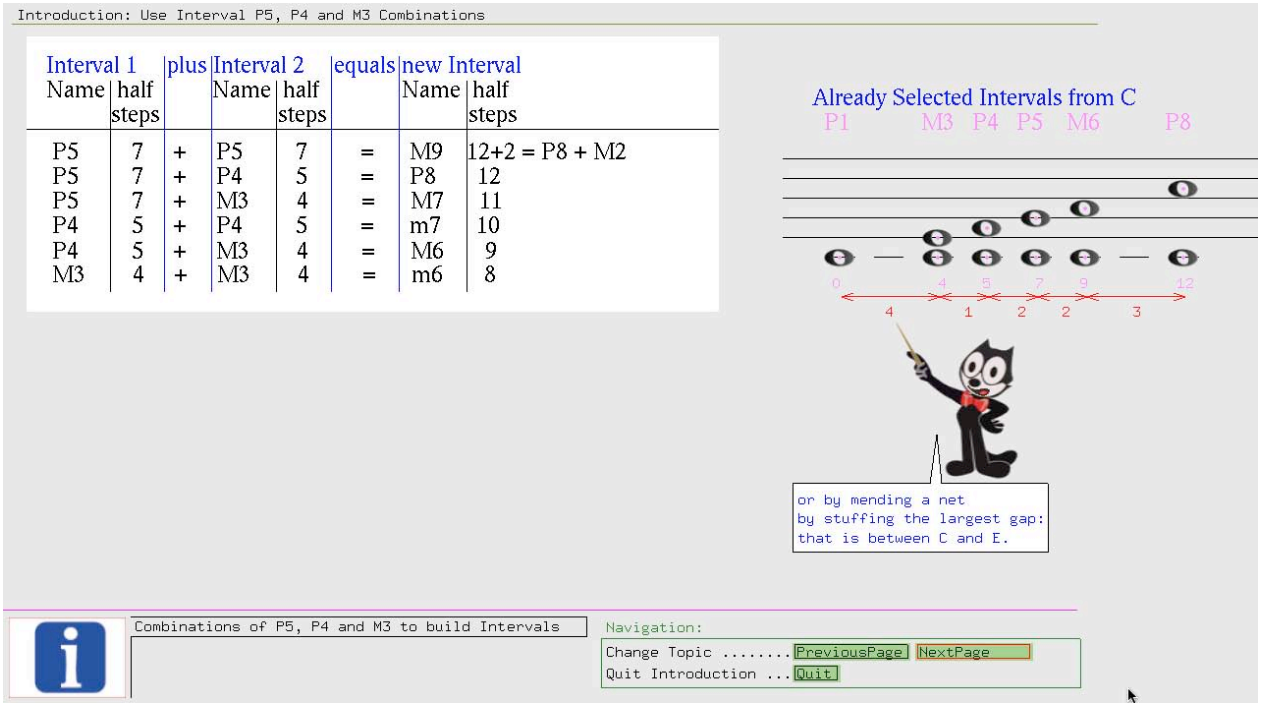
We think that the different combinations do not allow to make a distinction based on the intensity. Therefore, we have chosen the Major Second as the next interval to learn for symmetrical reason, or by mending a net by stuffing the largest gap: that is between C an E.


Introduction: Use Interval P5, P4 and M3 Combinations
Interval 1 Name | half steps | plus | Interval 2 Name | half steps | equals | new Interval Name | half steps
P5 7 + P5 7 = M9 12+2 = P8 + M2
P5 7 + P4 5 = P8 12
P5 7 + M3 4 = M7 11
P4 5 + P4 5 = m7 10
P4 5 + M3 4 = M6 9
M3 4 + M3 4 = m6 8
Already Selected Intervals from C
P1 M3 P4 P5 M6 P8
0 4 5 7 9 12
4 1 2 2 3
or by mending a net
by stuffing the largest gap:
that is between C and E.
Combinations of P5, P4 and M3 to build Intervals
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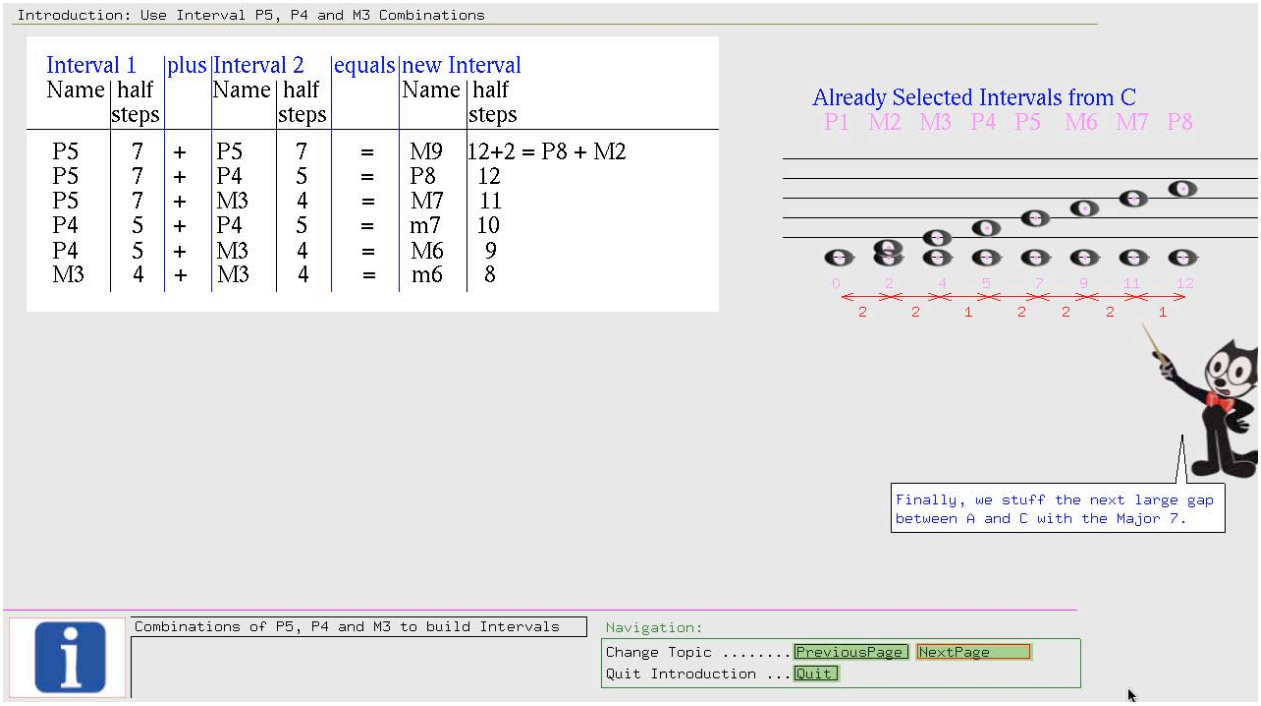
Finally, we stuff the next large gap between A and C with a Major Seventh.


Introduction: Use Interval P5, P4 and M3 Combinations
Interval 1 Name | half steps | plus | Interval 2 Name | half steps | equals | new Interval Name | half steps
P5 7 + P5 7 = M9 12+2 = P8 + M2
P5 7 + P4 5 = P8 12
P5 7 + M3 4 = M7 11
P4 5 + P4 5 = m7 10
P4 5 + M3 4 = M6 9
M3 4 + M3 4 = m6 8
Already Selected Intervals from C
P1 M2 M3 P4 P5 M6 M7 P8
0 2 4 5 7 9 11 12
2 2 1 2 2 2 1
Finally, we stuff the next large gap
between A and C with the Major 7.
Combinations of P5, P4 and M3 to build Intervals
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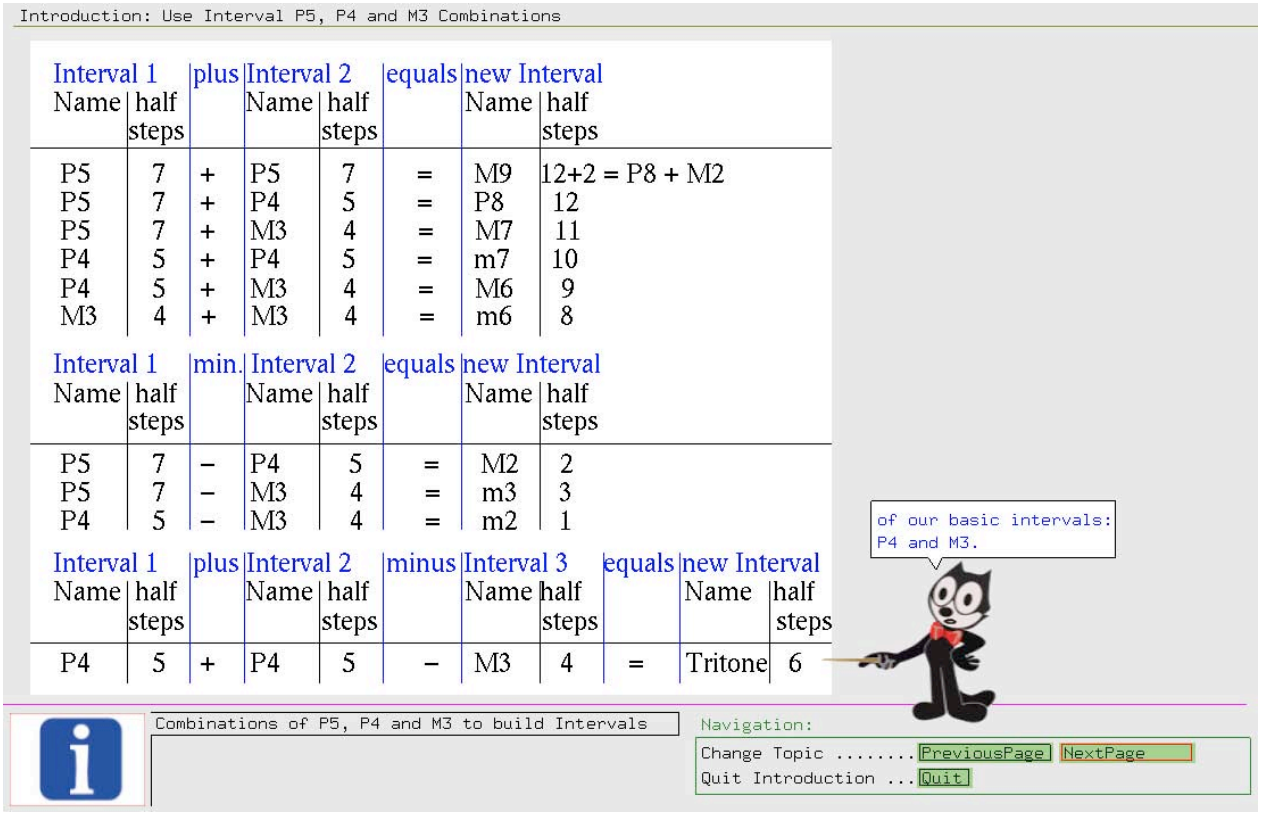
If we also allow subtractions, we can construct all minor intervals.

But we will not get a Tritone without using at least a combination of three of our basic intervals P4 and M3.


Introduction: Use Interval P5, P4 and M3 Combinations
Interval 1 Name | half steps | plus | Interval 2 Name | half steps | equals | new Interval Name | half steps
P5 7 + P5 7 = M9 12+2 = P8 + M2
P5 7 + P4 5 = P8 12
P5 7 + M3 4 = M7 11
P4 5 + P4 5 = m7 10
P4 5 + M3 4 = M6 9
M3 4 + M3 4 = m6 8
Interval 1 Name | half steps | min. | Interval 2 Name | half steps | equals | new Interval Name | half steps
P5 7 – P4 5 = M2 2
P5 7 – M3 4 = m3 3
P4 5 – M3 4 = m2 1
Interval 1 Name | half steps | plus | Interval 2 Name | half steps | minus | Interval 3 Name | half steps | equals | new Interval Name | half steps
P4 5 + P4 5 – M3 4 = Tritone 6
of our basic intervals:
P4 and M3.
Combinations of P5, P4 and M3 to build Intervals
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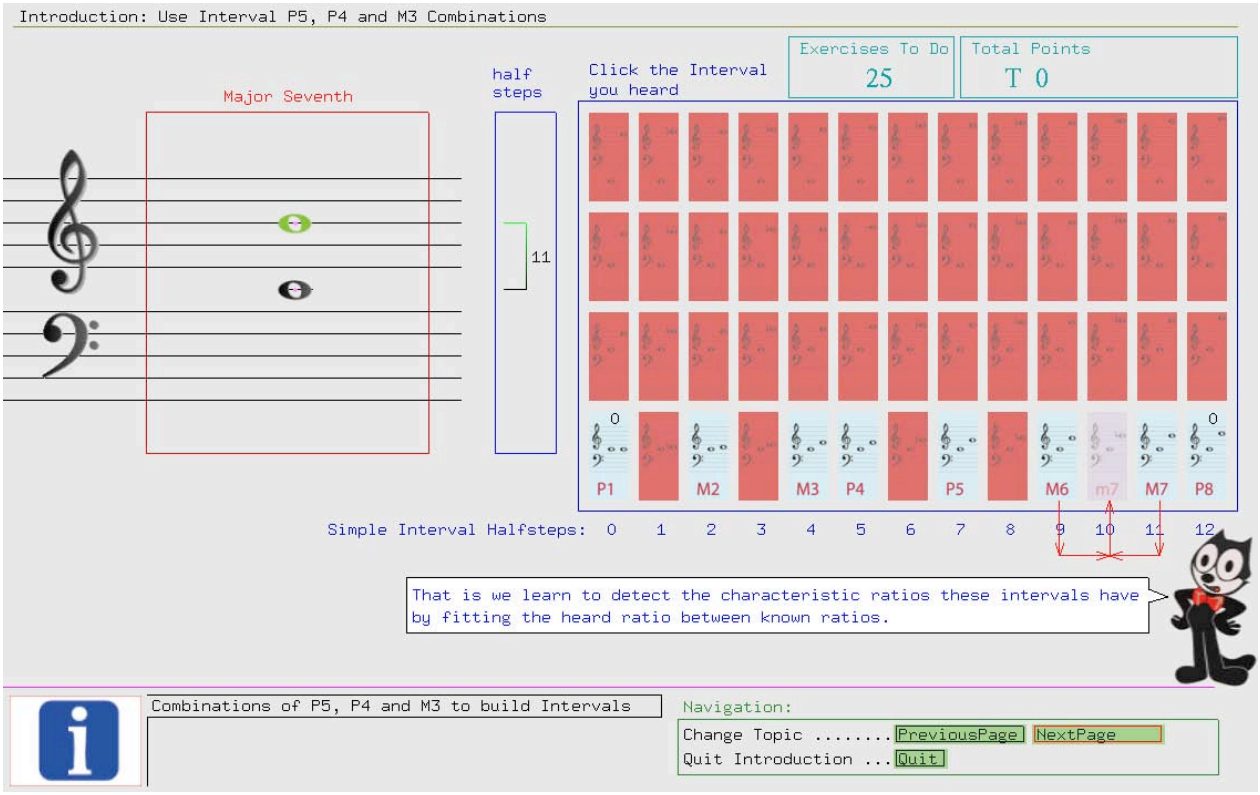
We do not favor a specific minor interval as the next interval to learn, since now all remaining intervals fit between a pair of already known ones. In this way the Perfect and Major intervals will give us an orientation grid where to place the minor and Tritone intervals.



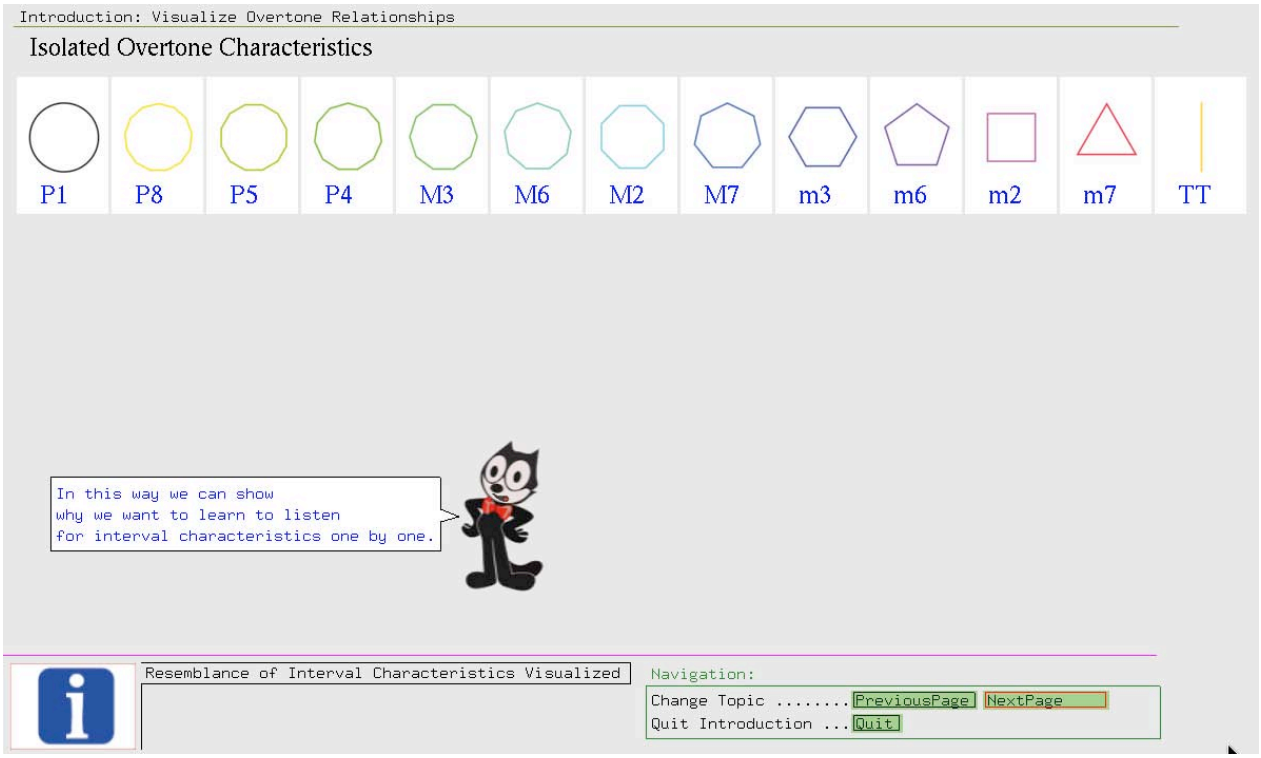
From a musical standpoint, we think that it is best to start the learning process for the minor intervals with the minor Third. It is musically contained in the Major triad as the upper interval. To summarize, here is our proposed order for learning the intervals:

- Perfect Unison
- Perfect Octave
- Perfect Fifth
- Perfect Fourth
- Major Third
- Major Sixth
- Major Second
- Major Seventh
- minor Third
- minor Sixth
- minor Second
- minor Seventh
- Tritone

Visualize overtone interval characteristic relationships

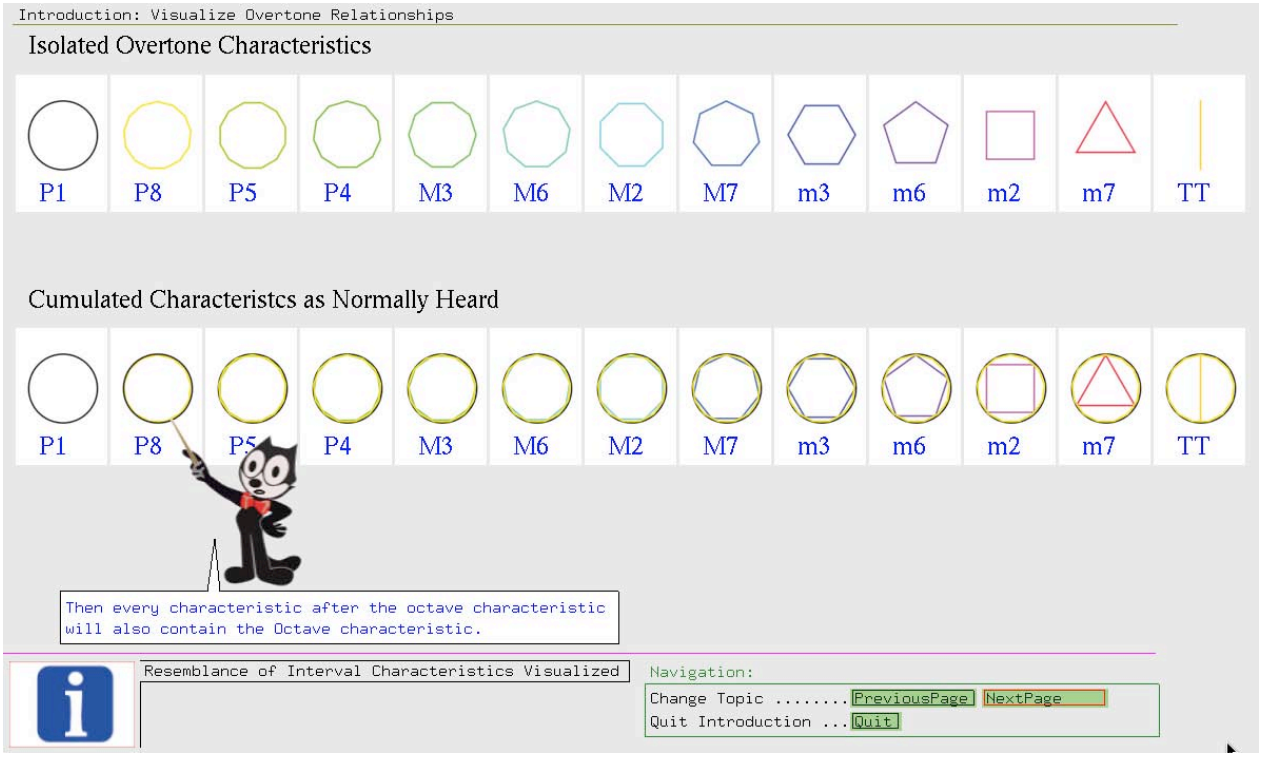
To emphasize that the order in which you learn the notes or intervals is more important than the speed with which you progress, we visualize the relationship between interval characteristics and the learning order.

We represent each interval characteristic with a symbol: a circle represents the fundamental. Then the intervals are represented as polygons in the order of their overtone occurrence, respectively our proposed learning order.



This allows us to explain, why we want to learn the most similar or most difficult to differentiate interval characteristics first.

Since the overtones come naturally in an order and are always simultaneously present, we have to add all previous characteristics to the characteristics we try to hear


Introduction: Visualize Overtone Relationships
Isolated Overtone Characteristics
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Cumulated Characteristcs as Normally Heard
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Then every characteristic after the octave characteristic
will also contain the Octave characteristic.
Resemblance of Interval Characteristics Visualized
Navigation:
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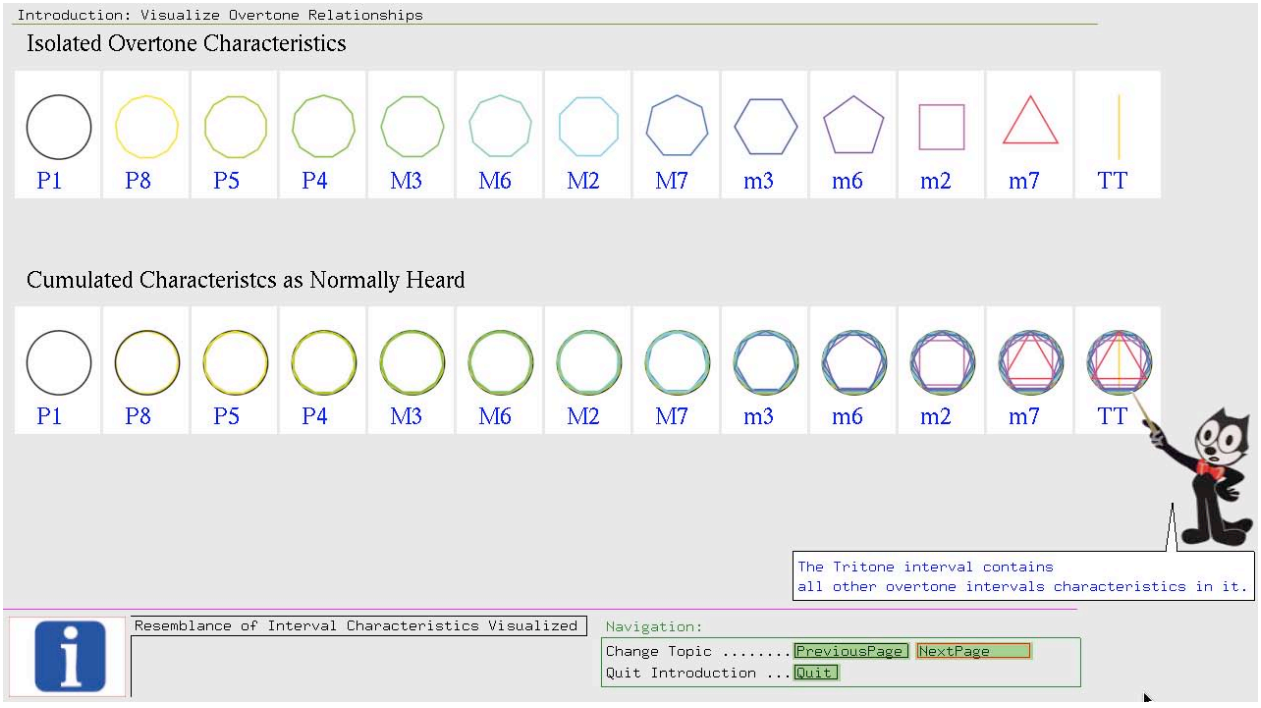
The fundamental characteristic is of course always hearable as the dominant sound. The first overtone, the Octave, has less intensity, but will be present anyway. Thus, every characteristic after the octave characteristic will also contain the octave characteristic. The same is true for the perfect fifth characteristic, and so on.


Introduction: Visualize Overtone Relationships
Isolated Overtone Characteristics
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Cumulated Characteristcs as Normally Heard
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
The Tritone interval contains
all other overtone intervals characteristics in it.
Resemblance of Interval Characteristics Visualized
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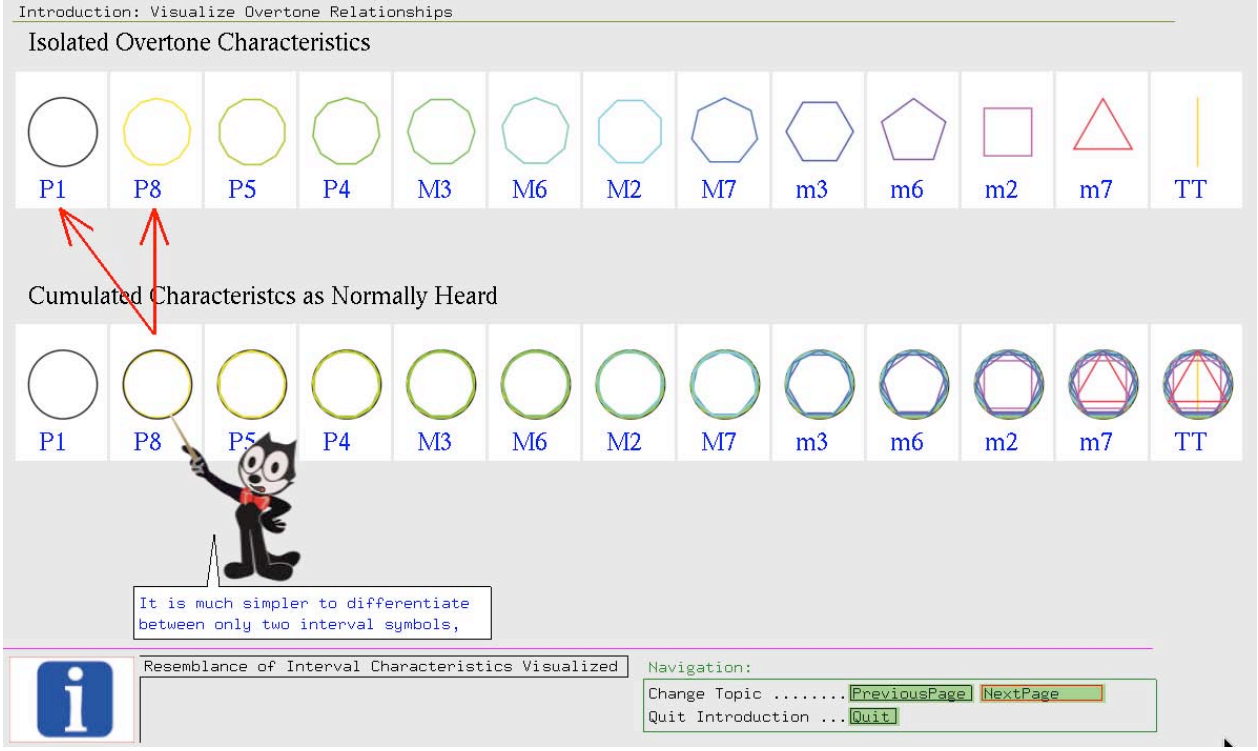
The tritone interval contains all other overtone interval characteristics in it.

While it is true that it is easier to distinguish a tritone interval from an octave or unison, than a perfect fifth from an octave or unison, it does not make sense to learn the Tritone first.

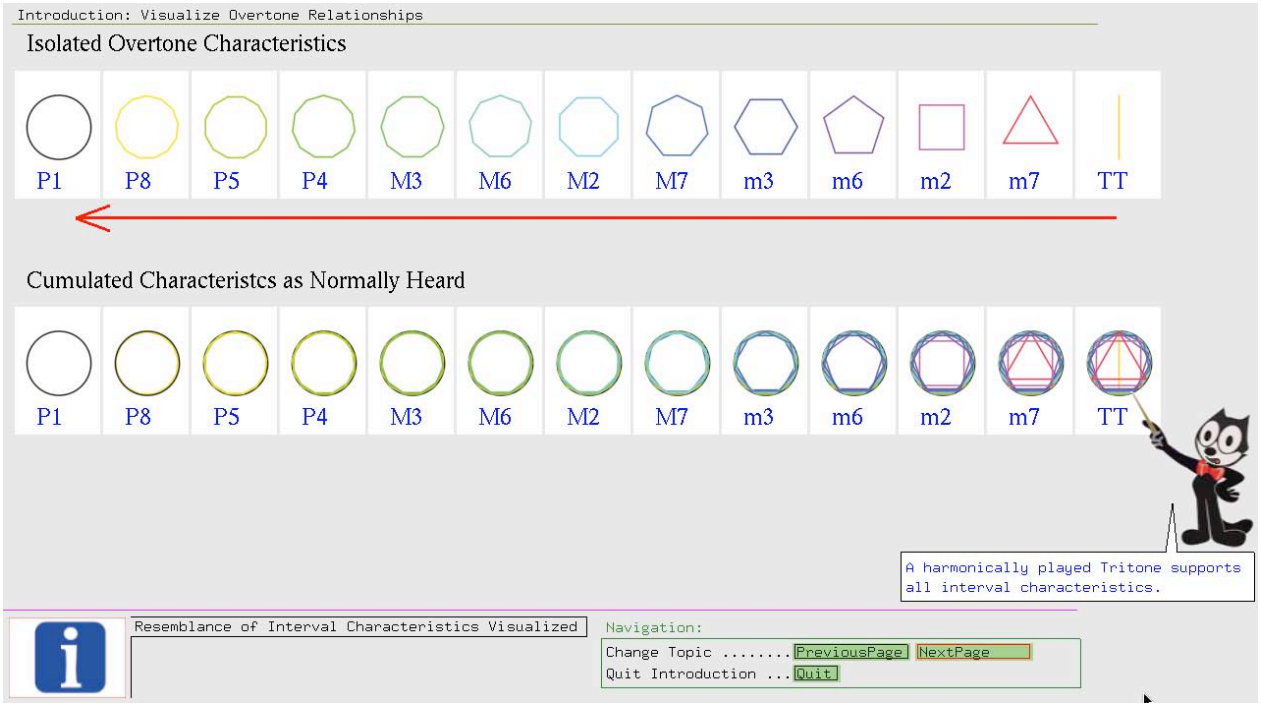
Since in our systematic learning approach we want to learn the characteristics one by one, it is much simpler to differentiate between only two interval symbols, - and therefore it is easier to learn the interval specific characteristic in a step-by-step approach -, than to extract a specific interval characteristic from complex sounds, which are accompanied by other interval characteristics.



It is difficult to concentrate on a single interval characteristic if you have many competing interval characteristics.

In our method you learn to grasp for interval specific characteristics as they appear naturally with decreasing intensity, and not the interval itself – with its entire harmonics. That is if we want to learn to hear the perfect fifth, we want to isolate the perfect fifth characteristic from other characteristics that are also present as much as possible. If we know the interval characteristics that come before the perfect fifth characteristic, then we can concentrate learning the new Perfect Fifth characteristic, by listening to a normal harmonic Perfect Fifth until we have fully grasped the difference between the previous interval characteristics and the new Perfect Fifth characteristic.

Thus each interval to learn should contain as few as possible other interval characteristics. A harmonically played Tritone supports all interval characteristics.


Introduction: Visualize Overtone Relationships
Isolated Overtone Characteristics
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Cumulated Characteristcs as Normally Heard
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
A harmonically played Tritone supports all interval characteristics.
Resemblance of Interval Characteristics Visualized
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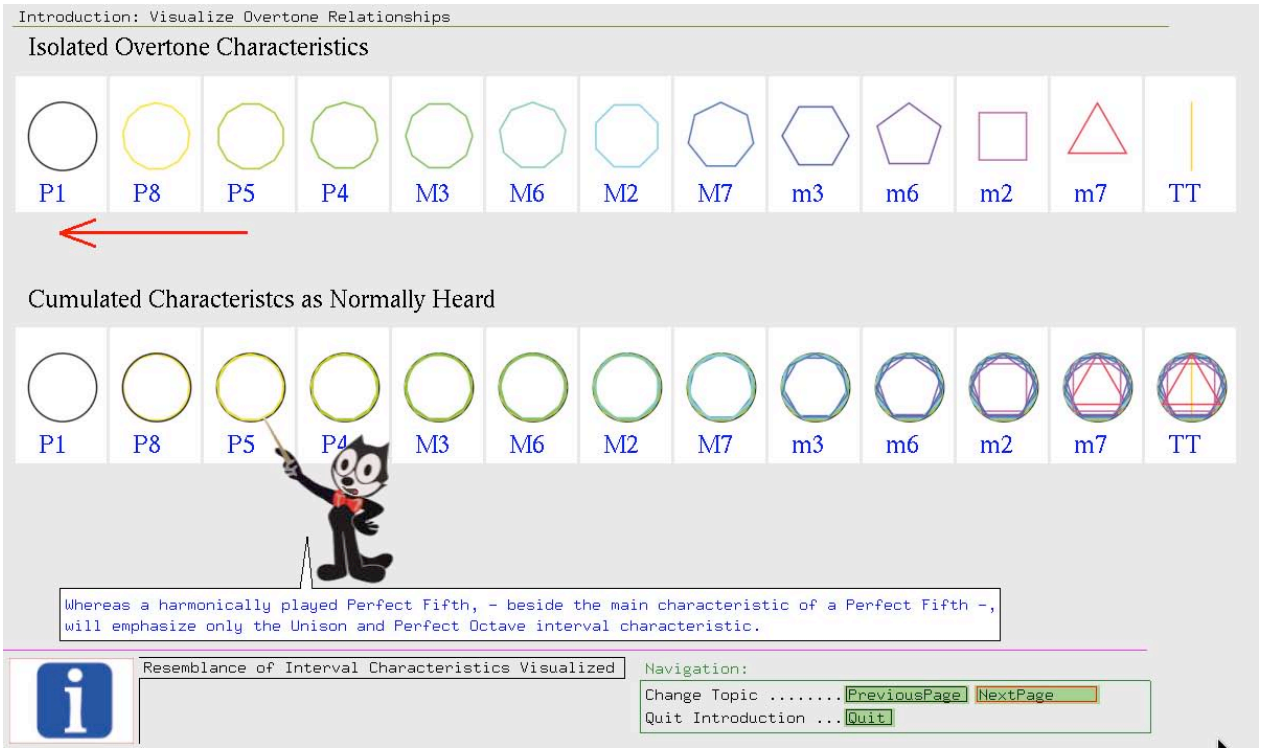
Whereas a harmonically played Perfect Fifth, - beside the main characteristic of a Perfect Fifth -, will emphasize only the Unison and Perfect Octave interval characteristic.


Introduction: Visualize Overtone Relationships
Isolated Overtone Characteristics
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Cumulated Characteristcs as Normally Heard
P1 P8 P5 P4 M3 M6 M2 M7 m3 m6 m2 m7 TT
Whereas a harmonically played Perfect Fifth, - beside the main characteristic of a Perfect Fifth -, will emphasize only the Unison and Perfect Octave interval characteristic.
Resemblance of Interval Characteristics Visualized
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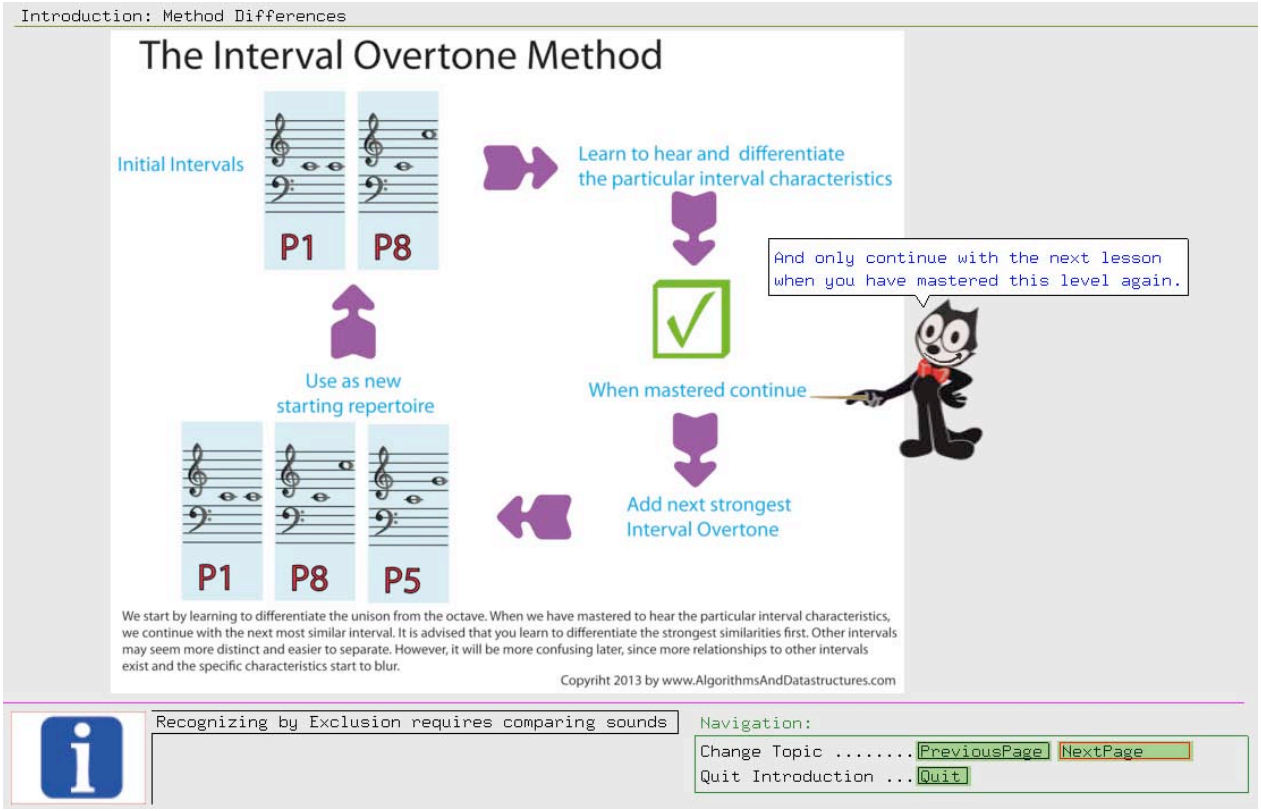
By adding only one new characteristic at a time, - the one that occurs naturally within the overtone series -, we learn to separate these interval characteristics from each other.

Because with the exclusion method we have to consult the already learnt interval characteristics intensively to come to a conclusion, we deepen the relationship between the intervals along the intensity of the overtones.

Unfortunately you have to be patient and make sure that you do not progress too fast. The exclusion method only works, if you can depend on already learnt material. That does not mean that you cannot do other methods in parallel. But when doing exercises with our Octave Anchor Pitches or Interval Overtone methods, please do not skip forward until you have reached a satisfactory level of confidence.

It is like building a tower: it takes the most time building the fundament, however, if you can trust your underlying layers, you can feel free to move on to the next levels securely.

Important: Never start a day with a new lesson! Always do a warm-up with the last successful lesson. And only continue with the next lesson when you have mastered the level again.


Introduction: Method Differences
The Interval Overtone Method
Initial Intervals
P1
P8
Learn to hear and differentiate
the particular interval characteristics
And only continue with the next lesson
when you have mastered this level again.
When mastered continue
Use as new
starting repertoire
P1
P8
P5
Add next strongest
Interval Overtone
We start by learning to differentiate the unison from the octave. When we have mastered to hear the particular interval characteristics, we continue with the next most similar interval. It is advised that you learn to differentiate the strongest similarities first. Other intervals may seem more distinct and easier to separate. However, it will be more confusing later, since more relationships to other intervals exist and the specific characteristics start to blur.
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Recognizing by Exclusion requires comparing sounds
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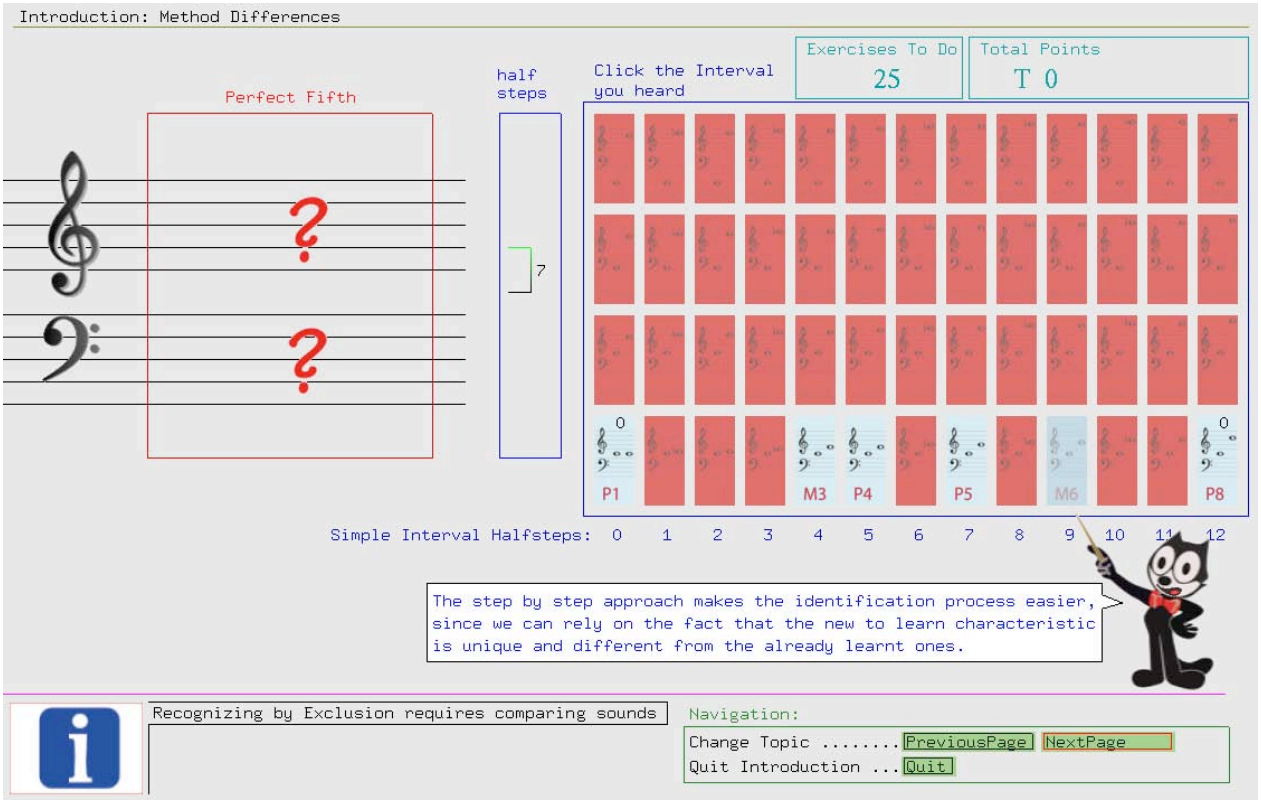
From the fourth overtone on, which reveals the Major Third interval characteristic, we have to strain one's ears. Since there is no new overtone needed to build the Major Sixth, the new, Major Sixth, characteristic is equally present when we learn the Major Third. However, since we have now a basic repertoire of characteristics, we can start to combine them and to place them into then already known grid of intervals.

The step-by-step approach makes the identification process easier, since we can rely on the fact that the new to learn interval characteristic is unique and different from the already learnt ones.


Introduction: Method Differences
Perfect Fifth
half steps
Click the Interval you heard
Exercises To Do
25
Total Points
T 0
P1
M3
P4
P5
M6
P8
Simple Interval Halfsteps: 0 1 2 3 4 5 6 7 8 9 10 11 12
The step by step approach makes the identification process easier, since we can rely on the fact that the new to learn characteristic is unique and different from the already learnt ones.
Recognizing by Exclusion requires comparing sounds
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Method differences

In the Interval Overtone method we follow the overtone series as explained above.

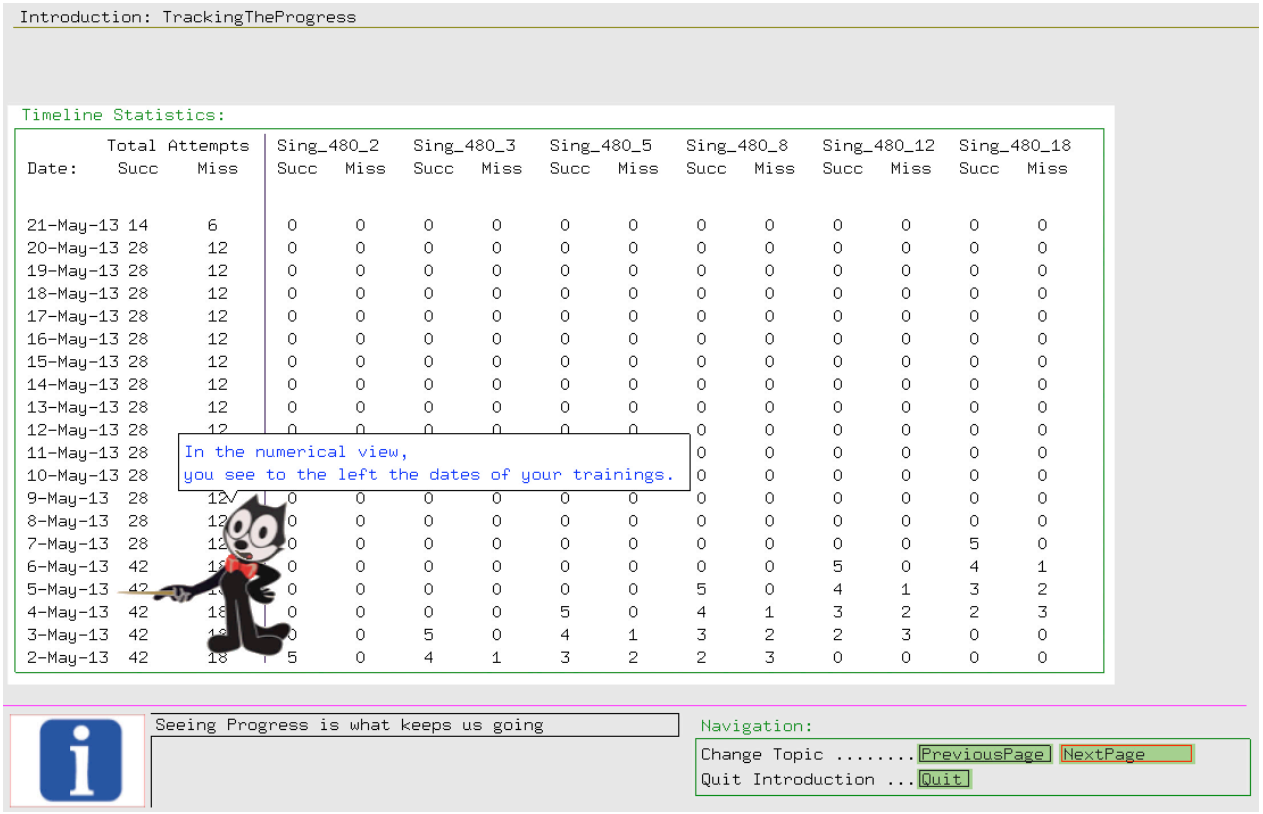
The Octave Anchor Pitches method is about single tone recognition. Since every sound has the same relative overtones, there is no order between single note-sounds. However the Octave Anchor Pitches method uses anchor pitches. That is, we expand our repertoire relative to these anchor pitches. Thus we have again an order to the starting anchor pitches.

The Singing Funnel method uses muscle activity to learn to memorize a sound. Since small muscle movements are easier to do, you should not start with sounds an octave apart. Since the overtone series is not relevant for the Singing Funnel method, you can start with any notes you feel comfortable to sing. You are not bound to an order.

Now, if you see that in the Singing Funnel method you have a good feeling for the note D, then you could take the note D instead of the note C as an anchor pitch in the Octave Anchor Pitches method, and adapt the method from there, by using the training mode in our exercises. But we do not recommend this, since the temptation that you would like to change the anchor pitch again - next week – is very high. In this way you may make faster progress in the beginning, but you loose the all important orientation. Here, discipline and stubbornness is the order of the day. And since the key of C is very common in music, our proposed way is not a bad choice.

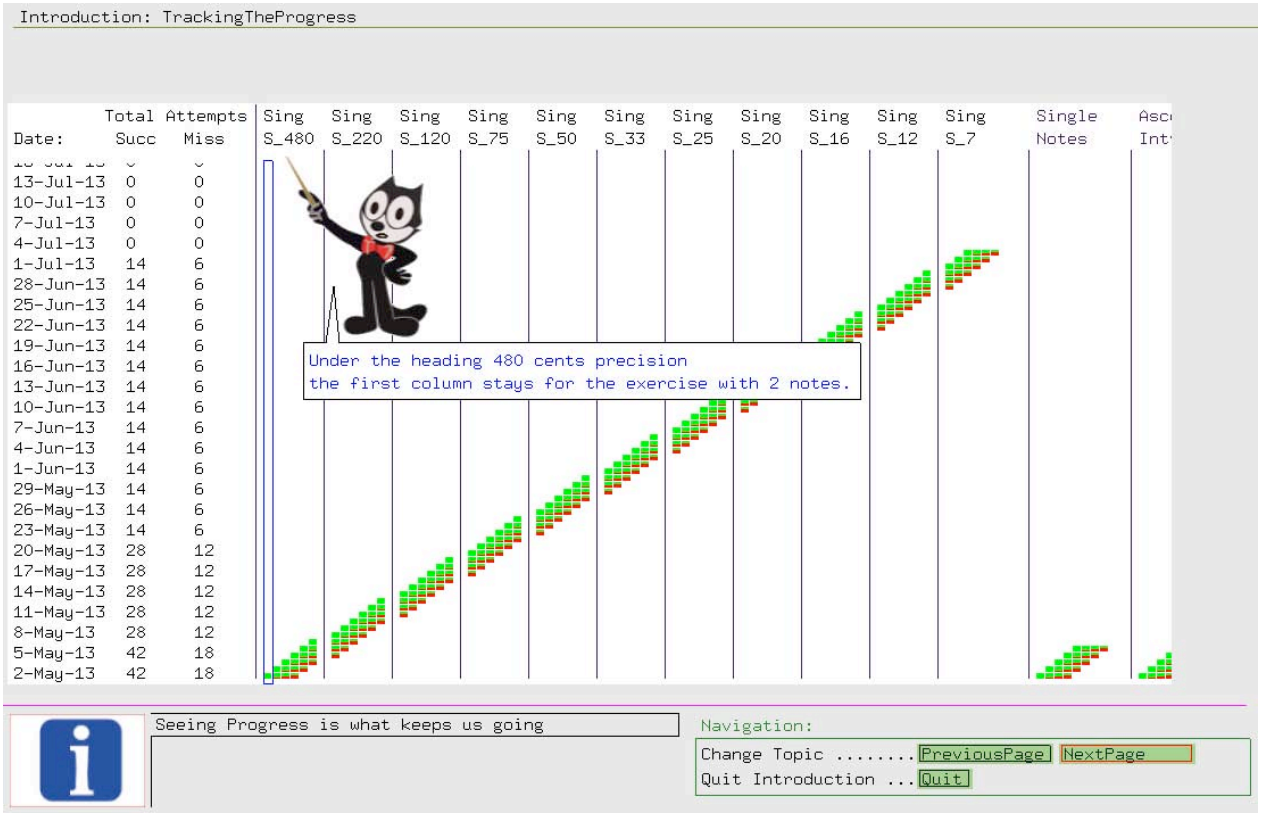
Tracking the progress

To stay motivated to continue something, it is important that you can see progress. Therefore we have introduced a timeline statistics. The timeline statistics will show you, in numerical and graphical form, where you stay.

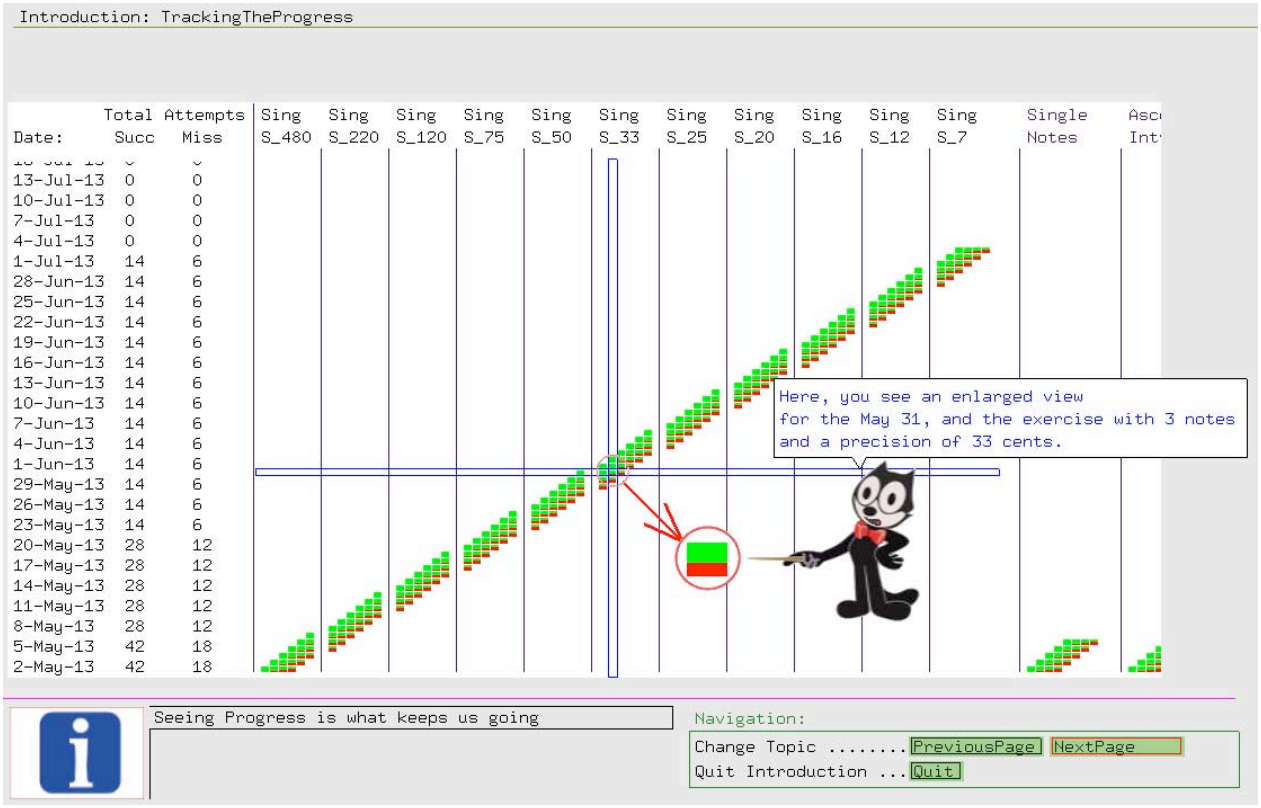


In the numerical view, you see to the left the dates of your trainings. And in the columns you see for each lesson: the successful and missed attempts for that day.

In the graphical view, you see a graphical representation of the ratio: correct to false answers. In the graphical view, for space reasons, only every third training day is displayed, as well as only the main topic is listed in the title column. However, there is still a success/failure bar for each day and exercise. For example under the title “Sing with a sensitivity level of 480 cents” the first column stays for the exercise with 2 notes.



Going from the bottom to the top, you track your daily progress. Going from left to right shows an increase in difficulty. The results for each day and exercise are depicted as a small ratio bar.


Introduction: TrackingTheProgress
Here, you see an enlarged view
for the May 31, and the exercise with 3 notes
and a precision of 33 cents.
Seeing Progress is what keeps us going
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Here as an example we have picked the results for May 31 and the exercise with 3 notes and a precision of 33 cents. On that day you had for this exercise about: 40 % wrong answers and 60 % correct answers. If the bar is red the ratio was less than 10%. A green bar denotes a ratio better than 90%.

Your progress pattern will likely not be as smooth and linear as depicted here. As long as with the time the picture gets greener towards the top: you are making progress.

Don't let you down, if –at a later time – some red spots occur in lessons you have previously mastered. You know that in case of set-backs you were able to reach a certain level before. In this case just repeat the previous successful lesson. Even if you miss the goal in the first repetition attempt, you should see that you can reach that level again much faster now. This knowledge about your learning process – we hope – convinces you to go forward with the method.

We wish you happy progressing with our methods.

Absolute Pitch Study

Please send us your timeline statistics after 100 training days, so we can improve our methods even further.

For current information about our AP-study and instruction how to submit your timeline statistics, please visit: www.listening-ear-trainer.com/AP-Study.html

We hope to get sufficient feedback to establish the concept of muscle memory and the effectiveness of our methods to acquire absolute pitch.

Thank you in advance for any feedback you may send us.

How do we remember sounds and pitches?

The following explanation is not based on scientific research, since science is still years away from understanding how the brain stores information. The explanations assume a simple model that might be compared to a computer system, one with a short- and long-term memory.

Sound Memory Introduction

While it is possible to remember complex sounds, such as a specific noise we are unable to reproduce them vocally, it is much easier to remember sounds we associate with meaning. For example, the pronunciation of foreign languages can be more easily remembered if we know the meaning of those words. If we are able to reproduce a sound vocally, then it is even easier to remember. In general, the more associations we can assign to a sound the easier it is to recall.

As a specific example, many people are embarrassed when, if they call a company to ask for some information, have a nice talk, not remembering their conversant's name at the end in order to say thanks. I have noticed that it helps to repeat the greeting, e.g. "Good afternoon Mr. So-and-so, I'd like to ask about …" Chances are much greater that you will remember the name at the end of the phone call. Further, if you write down the name, you can expect to remember it for a longer time, even without reviewing what you wrote. (And if the voice or name is difficult to understand, at the end of the phone call one might ask him or her to kindly repeat the name, gaining another opportunity to hear and memorize the sound or spelling of the name.)

The above example demonstrates that sound memory need not be an isolated or specialized memory, but is normally interconnected with other associations.

Sound processing

Computers process sound differently than we do. First the sound is converted from its analog waveform to sample points, similar to scanning a page digitally. The data in this sample form can be stored as actual sound or as actual image. Except for the reproduction of that sound or its picture, nothing more can be done with this kind of data. For meaning to work on a higher level the computer must abstract and convert the data into another form, via analysis of the data.

For another example, a page of text is scanned by optical character recognition. Thus scanned pixels are analyzed against character patterns. During this process, characters and words can be recognized, but in compressing the pixeled information into words, we lose information. For example, the size, font, and position on the paper are no longer applied to the text. For that information, the character recognition process must work harder, figuring out these additional attributes. However, since thousands of fonts available, and new ones are coming daily, the character recognition process must search more general descriptions, such as serif or non-serif fonts, for example. Even without this additional information, the condensed form still has the most important information: the *meaning* of the word, as we would find in a dictionary.
Speech recognition software is used to transform raw sound data into words and sentences. But again, we will lose information during this process, for example, volume level, pitch, speed, etc.

However, after this transformation the most important information—the words themselves—are now available for further processing.

Storing these higher-level abstractions uses far less memory than storing raw data. This higher-level storage also allows us to more easily process the data; the smaller storage size can be accessed faster. For raw data, there is never an exact match: even if the same person repeats the same sentence again and again. There are almost always differences in the raw data; therefore, it is important that the information is stored in a useful way, with not too much data and not too little. These higher levels of abstractions are important for communications. We can speak to and understand people we have never met before.

Another aspect of computer processing of sounds is seen in the synthesis of sounds. Midi files are files that store musical information as events. These events are defined by the start and end time of, for example, a specific note within a piece, its volume, the instrument used, or effects applied. The actual sounds are not stored in the Midi file. It is the task of the playback device to generate the real sound. Because of this, MIDI files are very much smaller than digital audio files, and the events are also editable, allowing the music to be rearranged, edited, even composed interactively if desired (see http://www.midi.org).

To generate the real sound of the piece, the playback device (on the computer) must synthesize the sound. The result of the synthesized sound depends on the sound samples stored on the playback device. When coupled with a Downloadable Sounds (DLS) synthesizer, MIDI files can be combined with standardized samples of musical instruments, sound effects, or even dialogue, which are used to recreate an exact copy of the sound intended by the composer. For our purpose, the point is that sound is stored in separate sound samples instead of as a digital file containing the whole piece. We will assume that a similar effect to recall sounds exists in our brain: Sound gets broken up into snippets and attributes. These stored fragments (sound snippets) can be combined in a sequence of actions to form step by step instructions to generate a certain sound (e. g. the MIDI file only contains the instructions (actions) for a playback device to produce the sound. The sound itself gets generated in the playback device with preloaded sound snippets)

Computerized speech recognition also compares incoming sound stream with sound-snippets, and stores the sound stream in small, meaningful tokens. The recognition process is then based on these tokens, since the computer can handle precisely defined tokens much better than raw, unstructured audio data.

Sound memory by reproduction

The most effective way to store a sound in our brain is to reproduce the sound ourselves. The reproduction of a sound is the strongest active channel we have to it. The recognition of sounds by far exceeds the ability to produce them. But the sounds we can reproduce make out the biggest part of sounds that were considered by nature as important for survival. Therefore, recognition of this part of sound receives special treatment in our brain.

Hearing and speaking are highly interrelated, and this relationship begins during childhood. When we learn to speak, we listen to what comes out of our mouth, so a child learns to actively control the means to change an uttered sound into a desired direction. The activity of speaking involves our muscles, which can be accessed by the brain as an additional association or link to

sound. Thus sounds that we can reproduce, can be processed differently by the brain than sounds we cannot. In the next paragraphs we will focus on this highly developed area of the brain, concerning sound.

Sound memory and muscles

To be able to reproduce a sound we use our muscles, although in daily life we are not aware of using them, either for standing in place, walking, or talking. The main function of our brain is to control our muscles, and it took thousands of years for the brain to master its control and to react to such muscle requirements as walking on two feet. Our balance system, which resides in the ear, or our perception of visual changes in the environment, are actually not the primary sources of input stimuli that keep us vertical. Arguably, the necessary muscle changes that keep us standing on two feet are based on automated reflexes, which the brain controls only peripherally (i.e. they would not work if we had no brain, but they become automated, and thus the brain is not needed directly). However, the brain's primary function is still to control muscles and the brain can overwrite reflexes.

To utter words, then, the vocal cords play an important role. If you say "Ah," then "Oh," you have no clue what commands your brain has given the vocal cords. Yet, the sounds come forth correctly and certainly muscles were involved. This is because somewhere your brain has stored the muscle patterns for "Ah" and "Oh." It is capable even of finely controlling the vocal cords to express "Oh" as indicating surprise (Oh, what a surprise to meet you here) and "Oh" as indicating simplification (Oh, that's easy, everybody can do that). Thus sounds are stored along with muscle movement information in the brain, and this stored muscle-movement data can be modified with several attributes for final production of the sound.

Since what is important in producing sound falls into the process of actively producing it, we can assume that the sound is stored only once, in the muscle memory. We need this muscle-movement information anyway, when we want to speak, so it makes sense to have the information stored primarily in this part of the memory. Storing once for use in many situations reduces redundancy and helps to clearly differentiate meanings and attributes. With the descriptive attributes, we will change and combine the stored sound snippets to produce the final sounds. When we recognize a sound, we can analyze and categorize it, then assign it appropriate attributes with their different meanings. This breaking down in order to distinguished attributes helps us to recognize danger, or where we need to take immediate action. When in danger, our actions usually involve muscle movement; therefore, to react quickly it makes sense to have analyzed sounds stored together with fight or flight schemas in the muscle memory. Of course, we store non-reproducible sounds somewhere as snippets. However, sounds stored in muscle memory will get priority, as they reside in the overlapping area of sounds deemed important, therefore evaluated quickly. So, our muscle memory—the brain's primary control center for survival—allows us to think about (or reflect on) everything we put in it, with accompanying stored attributes, and to combine these in different variations. This cannot be done with raw, unstructured sounds. (e.g. we would not be able to understand people whom we have never met before).

Using muscle memory to store pitch

Since the voice does the speaking, and therefore strongly related to listening, muscle memory is the most appropriate place to store pitch sounds, too. As the brain was built to control muscles, it

stores various pitch patterns at a very high precision. Humans have little reason to think consciously about sound memory except when they have to identify or classify sounds. Keeping a sound in our memory for a few seconds allows us to compare an actual sound to a stored sound. If doing training with the Singing Funnel method, you soon notice that when you start to lose concentration, then you rely on muscle memory to continue scoring. That is, you will stop using your “inner ear” imagining the sound, and only concentrate on the producing part of the sound. That is trying to remember the position of the muscles that produced the correct answer last time. Of course, you will score if you produce the sound correctly, without imagining the sound with your “inner ear”. This process is fine; it helps to calibrate your ”abstract note to pitch understanding” with the muscles and reinforces the relationship between pitch and muscle memory. In the same way you can observe how professional musicians might take over a pitched sound on their instrument, humming it to keep the sound in focus longer. (you don’t have to use your “inner ear”, if you hum the sound: the muscles are in place).

Or, in other words, it uses more brainpower to imagine a sound (and hear it with your “inner ear”), than to recall the states of muscle positions. Of course they are related, since if you want to hear a sound with your “inner ear” the muscle memory gets activated. But you can also start building a link from an abstract note name to muscle positions without building up the sound in your “inner ear”. Of course the goal is to strengthen your “inner ear”, however, on the way to your goal you will also include separation of different actions and attributes.

Have you ever observed a person mimicking another? She or he not only uses the voice but the muscles all over the face and body. Thousands of years after the Stone Age, muscles still play an important role—not merely for walking.

Dyslexic people can learn to differentiate right and left by remembering in which hand they hold a spoon, training in muscle memory until that association becomes a reflex. These observations all tend to support the idea that we have muscle memory for sounds. If we did not, you could still substitute muscle memory for the sort of memory you know exists, or the researchers find which will have at least a positive effect on the recall of sounds and pitches.

Why use solfège syllables?

Fixed “Do” solfège syllables support the process of assigning pitch to singable syllables. Over time one gets better at producing correct pitches, until it is as easy as saying “Ah” or “Oh.” The Singing Funnel method lets you do exercises down to a precision of seven cents, so you can be very confident of hitting a particular pitch solely with the use of muscle memory. If you relax, the mind can more easily remain open for new information, and will allow the true sounds of solfège syllables—without processing—to enter short-term memory. Working with the Singing Funnel method allows you to receive the necessary feedback, showing when you are on the right track. Therefore you can be relaxed knowing that you sang a pitch correctly. Later, when you recall the sound, you can rely on your muscle memory. This confident and relaxed state helps the sound move from the short-term to the long-term memory. At the same time it will be processed and associated with the solfège syllable, thus the corresponding pitch. (Of course, this works only for Fixed Do.)

Fine mechanics are involved in producing a sound using the muscles in your vocal cords to control the voice. How the solfège system helps to calibrate this muscle memory can be explained

with an analogous experiment, which reveals the events in this process. Follow the instructions below to learn more:

While standing, stretch out your arms horizontally. (In order to know whether they are exactly horizontal you would have to have measure with a level of some kind.)
Now do the same motion with closed eyes.

You will not be able to discern if your arms are horizontal or not, but with an external guide (person), you could learn to position them horizontally with closed eyes, or at any desired angle. The external guide would tell you to raise or lower them. You repeat this experiment until you have reached very good precision with closed eyes. Maybe not perfect to the degree, but you would achieve pretty close results. Of course, your brain uses every bit of information it can, for instance, the position of your feet. Thus the environment influences your awareness of how your arms are positioned in relation to earth. Standing on a steep hill will likely make you adjust to imperfect measurement of horizontal. But if you train in several different environments you will master the additional conditions.

So, to apply this analogously to controlling the vocal cords, you can train their muscles to produce a desired pitch. With such training, you can fine tune your vocal cord muscles precisely and produce a correct pitch in different situations. If you associate the solfège syllables to corresponding pitches, the muscle setup for each syllable will itself guide you to almost produce the correct pitch without fine-tuning. The more you train in different situations (e.g. in the morning or evening, standing, sitting, etc.), the better you will master the relationship between the vocal cord muscles and the solfège pitch.

Recognizing words

To recognize words, your brain has to compare the physical sound you hear with patterns stored in your memory. If the brain can match a sound, it will present you with its stored meaning, for example, when you are in danger, or finding food, or discerning if other humans are in the direction of a sound. But when the brain matches a sound to a word, we can write it down or repeat it. We can also repeat a sound without any meaning; actual sound pattern memory, or the memory used to recognize special noise. Still, to repeat a sound you use the vocal muscles do the work of the repetition, so the motions of the vocal cords must be stored somehow. The brain controls muscles and stores their actions in muscle memory.

Words can be repeated using the short-term, abstract sound memory (i.e. the memory that holds the actual sound patterns without their meaning) or with individual interpretations of their meaning. In most cases the brain prefers to store the abstract meaning of the word instead of using the sound pattern memory. In the computer, a stored word uses a lot less memory than it would take to store the sound of that word. When the same word is spoken by different people a different sound pattern is produced by each. The same is true for different musical instruments, which produce different sound patterns even if they play the same pitch. Loud or soft dynamics do not change either the meaning of word or the pitch. Thus the abstraction of a pitch or word makes sense to the brain and only the pattern of the muscle memory for the interpreted word gets stored.

However, the actual sound memory is separate, where sound patterns from short-term move to long-term memory. This is especially true for sounds heard repeatedly, and for which additional attributes are also stored. For example, you can hear the voice of your mother with your "inner ear," but the majority of the sounds will not be stored as patterns, but as attributes. Dialect (region), Accent (foreign language speakers), casual vs. formal speech, omissions (swallowing endings), or attributes like croaky, harsh, hoarse, rough, cracking, sharp, etc., will be stored and assigned to a speaker. The storage of sound pattern seldom makes sense, since it makes more sense for the brain to store only the meaning. When we hear our mother with our "inner ear" we supplement the meanings with the attributes associated with her and mix them with stored raw-sounds from the long-term memory.

Of course, our parents play a major role in this process. In our early childhood, much data will be stored as raw data. Later this raw data will be used as building blocks, to understand and produce sounds. Throughout life, meanings will be associated to sounds, and we also develop the ability to differentiate other attributes. From our parents we collect and store many attributes, and at first we precisely hear our mother with our "inner ear." However, not all data from our mother will be stored as raw data. Especially when we get older, the brain accumulates enough attributes to start managing and thinking using meanings instead. Thus as we grow, the brain begins to store meanings and only links them to our mother's attributes. We might even hear our mother's voice with our "inner ear" speaking sentences she never had actually said, for example, in our dreams. Thus we construct our sound imaginations, which can be so precise that we cannot distinguish them from real sounds.

Recognizing Pitch

From the above reasoning, we can conclude that pitches, too, get stored in muscle memory (at least as a basic attribute). People who have absolute pitch but do not actively sing, I assume, perhaps have built a relationship during childhood from the brain's memory to at least one pitch. This may have happened during the bubbling phase, where an active, uttered pitched sound pattern got stored along with a pitch attribute. Other pitches may be determined later by relative pitch, without the necessity of actively producing the sound. Recognition of those other pitches will take place as fast as recognizing vowels, unconscious to us as a separate step. The recognition process is the same as for words: if a match can be found, we can name the corresponding note name.

The recognition process for note names can be as fast as the recognition process for words. Since a meaningful sound goes along with the stored muscle pattern, your "inner ear" will make use of this storage. Just as you can mentally hear words without speaking them, you can hear pitches in your "inner ear" without singing them. The production of a correct pitch through singing can be as easy as saying "Ah." Now, that is slightly exaggerated; if you do not sing everyday, it is of course much more difficult to sing than to speak. For singing accurately, you must bring your vocal cords into specific positions and tension. To sing a pitch in tune you must also control your breathing by controlling the airflow through your vocal cords. Our product "Listening Singing Teacher" gives you real-time feedback on pitch accuracy and helps you to control your vocal cords. Therefore, by training your muscle memory with the Singing Funnel method, you can supply the missing musical education by remembering sounds with muscle memory, and improve your listening skills to have absolute pitch.

Since the only way we can produce a sound is through our vocal cords, it follows that we hear pitches with our "inner ear" from their muscle memory. The process has to include the activation of our muscles, so it also makes sense that pitch gets stored in the muscle memory as well. Since the brain likes to store information as attributes, the timbre of an instrument, for example, will be stored in a separate attribute. Using our "inner ear," the brain tries to match our associated solfège syllables (or the sound of another instrument for that purpose, if we have trained during childhood) to the real sound. If a match is found, the recognition process is complete.

Since singing is an active experience, we can improve it by training. If we sing correctly, and tap into our muscle memory, we will recognize pitches correctly. Since the brain likes to store information in meaningful categories, it is capable of isolating the pitch attribute of any instrument by comparing it to the pitch attribute of the voice, or the pitched solfège syllables. Pitches outside the singing range need additional brainpower to be recognized. To recognize pitch without singing is very difficult to accomplish after the brain has switched from raw data collection to the more powerful meaning and attribute system; the latter system tends to get in the way. Of course, your brain can still collect raw data, but it will do so to a much lesser extent. You must use special techniques to overcome this situation (e.g. hypnosis, or other psychological relaxation methods that reopen the mind for raw data collection).

But the brain is always open for raw data, which can be shown with learning foreign languages. You can repeat sounds of a new language with little or no difficulty; however, the transfer to the long-term memory takes longer. Since the brain cannot assign known attributes to a new sound, it needs repetition and corresponding stimuli (visual, textual, and other sensory stimuli) in order to assign meaningful attributes to the sound. Otherwise the brain will refuse to store the "meaningless" sound in the long-term memory. Again, for learning a foreign language, the active speaking of the words helps the learner tremendously.

The Singing Funnel method used with the voice is much easier and effective than, say, training with a piano, as the learner's progress is better shown immediately and tracked in a way that stimulates further practice. This learning process can be accelerated, as any other learning process, by multiple stimuli, especially through activities. Activities highly related to the subject will bring the fastest results and, in the case of pitch recognition, singing is the best.

Recognizing pitches is similar to recognizing language. We learn our mother tongue automatically, just as, if exposed to pitch exercises, or we have a special relationship to a musical instrument during childhood, we are able to recognize pitches later. But if you missed that opportunity, you would learn pitch recognition much like learning a foreign language. What actively speaking is to language, singing is to pitch recognition. Similarly as for learning languages, it gets more difficult to learn absolute pitch as we get older, but it is never too late.

Of course, past a certain age, the production of a correct pitch through singing is not as easy as saying "Ah." The recognition process takes longer, but if you want a challenge for the second half of your life, for example, learning to recognize pitches is good for the brain in warding off memory problems, dementia, and even Alzheimer's disease. The Singing Funnel method can help you by structuring your learning process with step-by-step feedback and tracking your progress.

Learning Tips for Listening Ear Trainer

Microphone settings

For pitch exercises set the input level as high as needed, so you can sing comfortably without stressing your voice.

Environment

If possible, practice in a quiet room. Use a low noise computer and have as few as necessary electrical fields in the room, e.g., turn off your mobile phone and other equipment. Be aware that long microphone cables can cause audible disturbance. Finally, the room should have fresh air.

Recognize trends

Using the statistics, see if you have a tendency to sing some notes too high or too low.

Variety and confidence

Once you have reached a certain level, try to vary the exercises. Instead of solfège syllables, sing your answers using different vowels. Mastering other sounds adds flexibility and will increase your confidence.

Absolute ear and chords

Listening Ear Trainer helps you to acquire a sense of our music system, but in a somewhat isolated way. It does not progress through musical patterns, such as scales, or through triads. But since tonal music follows rules, after awhile it is easy to predict which sounds will come next. This limits choices and thus supports relative pitch recognition. To get a feeling for absolute pitches, you have to work with a "detached," non-predictable system. That is why our system tests your interval recognition ability without sticking to a key. The intervals are presented from a randomly chosen note. The names of triads and seventh chords are easier to identify, as they have more than one note, and thus more anchor points (pitches). Identifying a chord quality is always done using relative pitch; the chord quality solely defined by the distances between the notes it is built from. So, to find the other two notes of a Major triad in its root position, the third is found by ascending four half-steps from the root, and the fifth by ascending three half-steps from the third. Thus the chord quality is independent of the position of its root note.

Finding a music teacher

If you like music and want to express yourself on an instrument, it is recommended that you take lessons. In the beginning it is particularly important to be supervised with simple things like sitting comfortably, good posture and handling of the instrument, having good sight of the score, and relaxed execution. If you learn these things incorrectly, they become big hindrances to making progress later when pieces get more difficult.

Practice times

As with learning another language, it is recommended that you practice in several short sessions rather than one long one. We also suggest taking a break every 15 minutes or so. It will also enrich your experience if you do an exercise in the morning, then again around mid-day, and another in the evening. You may find that your perceived recognition, and performance, is different at various times of the day.

FAQ

What do I get for my money?

Your payment allows you continued use and access to all lessons on the computer where the software was installed. There is no warranty on the software, but we will try to fix any errors. If you discover a software fault, please notify us. However, tracking down errors on machines other than ours is very complicated; therefore, please use the software in the trial mode first.

Your payment allows you to use the program for requirements described in the Set-up. Operating system changes may render the program unusable, and we give no guarantee that we can fix the program if used with another system.

What happens if I do not register after 100 days?

You break the rules, but we hope you will not. Many people will try this program for free, and they are allowed to do so for 100 days. If you still want to use the program after 100 days, it seems that the software is useful to you: therefore paying is only fair.

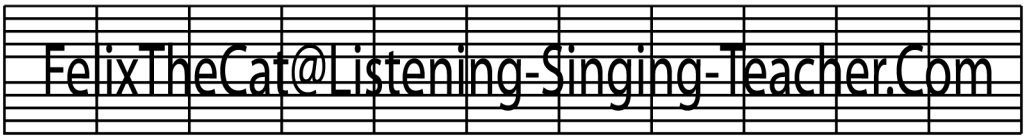
Where do I get support

There is no telephone support hotline, but we are interested in improving the product. If you find errors or experience program crashes, let us know. Tell us also about documentation errors, sound errors, or any other suggestions for improvement of the program. If the program stops unexpectedly, see the system console log for error messages. If the problem can be documented by a recording, export the recording and send it along with an error description to the address given below.

Troubleshooting tips

Check to see if you can download a newer version with the same major version number. If so, back up your old version before installing the newer one and try reproducing the error.

If no pitch curve is displayed, check the sound control panel to see that the default input device is working correctly. If the input level is too low, increase it with the slider. If this does not work, you may have a microphone not suited for that input channel. Expensive microphones often need special pre-amplifiers. The input channel must support microphones; line-in input channels expect a higher voltage signal than what is provided from standard microphones. There may also be a separate control panel for your digitizing device to adjust the sensitivity; check your hardware manuals. If you hear a lot of background noise, make sure nothing else is disturbing the audibility. If there are clicks, chirps or audible hissing, you might have unshielded microphone cables picking up electro-smog, or the microphone itself picking up a grumble from the 50/60 Hz power outlets. Try to reposition the microphone/cables. Make sure that the volume level display is in the correct range. If it is quite the sound control panel should show zero input-level indicator lights (otherwise some electrical interferences are around).

Send all the information (e.g. Computer Model, RAM, graphic card, audio equipment, etc.) that might be helpful in resolving the problem to:

Can I print the statistics?

Unfortunately, this version does not contain a print feature. You must make hardcopies of the windows by pressing the Print button. (for Macs, use the application grab from the utilities folder (or press Command-Shit-3)).

Why the elaborate licensing terms? Is the use of software all at my sole risk?

In today's modern world, where everybody can sue everybody for everything, one has to be cautious. If you are a super soprano and can break glassware just by singing, please do not blame Listening Singing Teacher for your destroyed property; we will not pay for it in such circumstances. Even worse, if you are a bass who could destroy Jericho (Jericho was brought down by sound-waves, according to the Bible) (hopefully you do not live in New York) …

Software is very complex, and computers are configured in different ways (some have problems of there own, so even the order in which you install the software may be important), and we cannot predict the behavior of the program. Therefore the risks of downloading, installing or running the software are yours. If you fear that this software will destroy your computer or data, do not download, install, or run it. We cannot guarantee that the server from where you download the software has not been hacked or that, during the transmission, no manipulations were made.

Do I have to be online to use the software?

No. You only have to be online to download the software and activate the serial number.

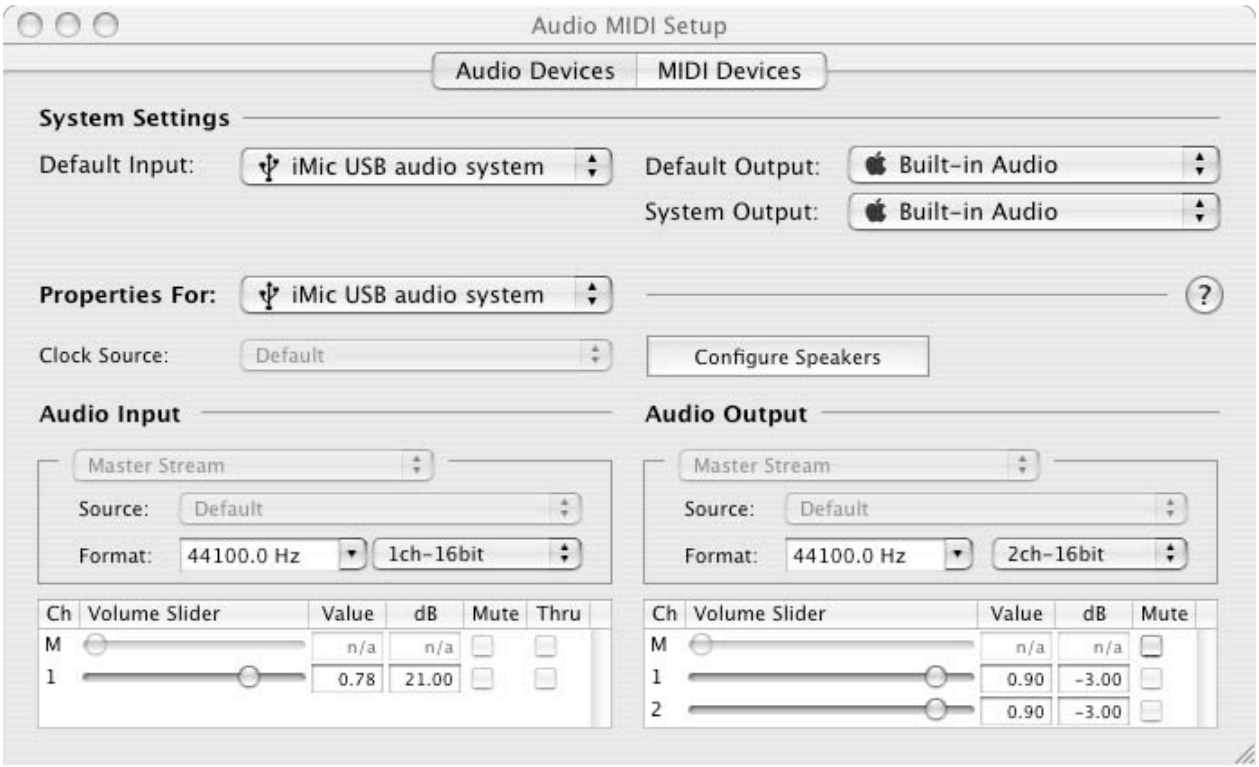
No sound for low notes

If you set the instrument to "Sinus," you need a good headset to hear the low notes. Mediocre loudspeakers can have difficulty reproducing frequencies below A2 (110 Hz). The Flute option has more overtones and thus will be easier to hear.

Microphone Input level too low, distortion or audio device not supported (Macintosh)

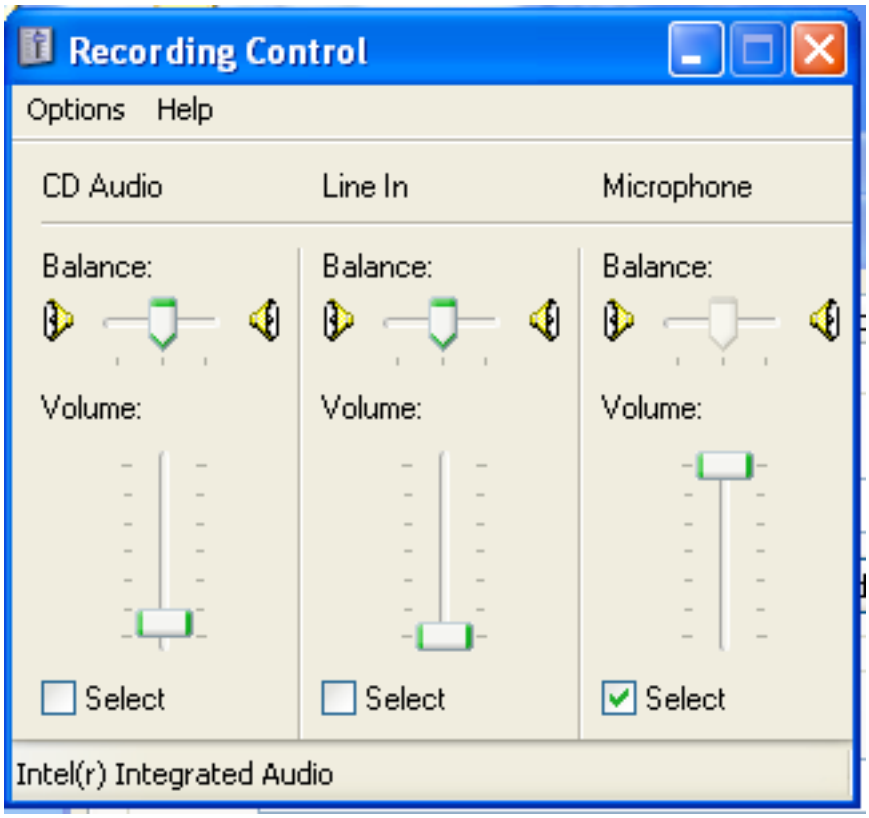
In the applications Utility Folder open "Audio Midi Setup," and Select the "Audio Devices" Tab. From the "Default Input" drop-down Menu choose your microphone and in the "Properties For" also choose your microphone (see below). Drag the slider on the bottom of "Audio Input" to the right. Also make sure that the selected format is 44100.0 HZ and one channel 16 Bit (1ch-16 Bit).

Other audio applications (e.g. GarageBand) may reset the input level, the frequency, or the 16-Bit setting to 8 Bit. Be sure to check and set the following settings correctly:



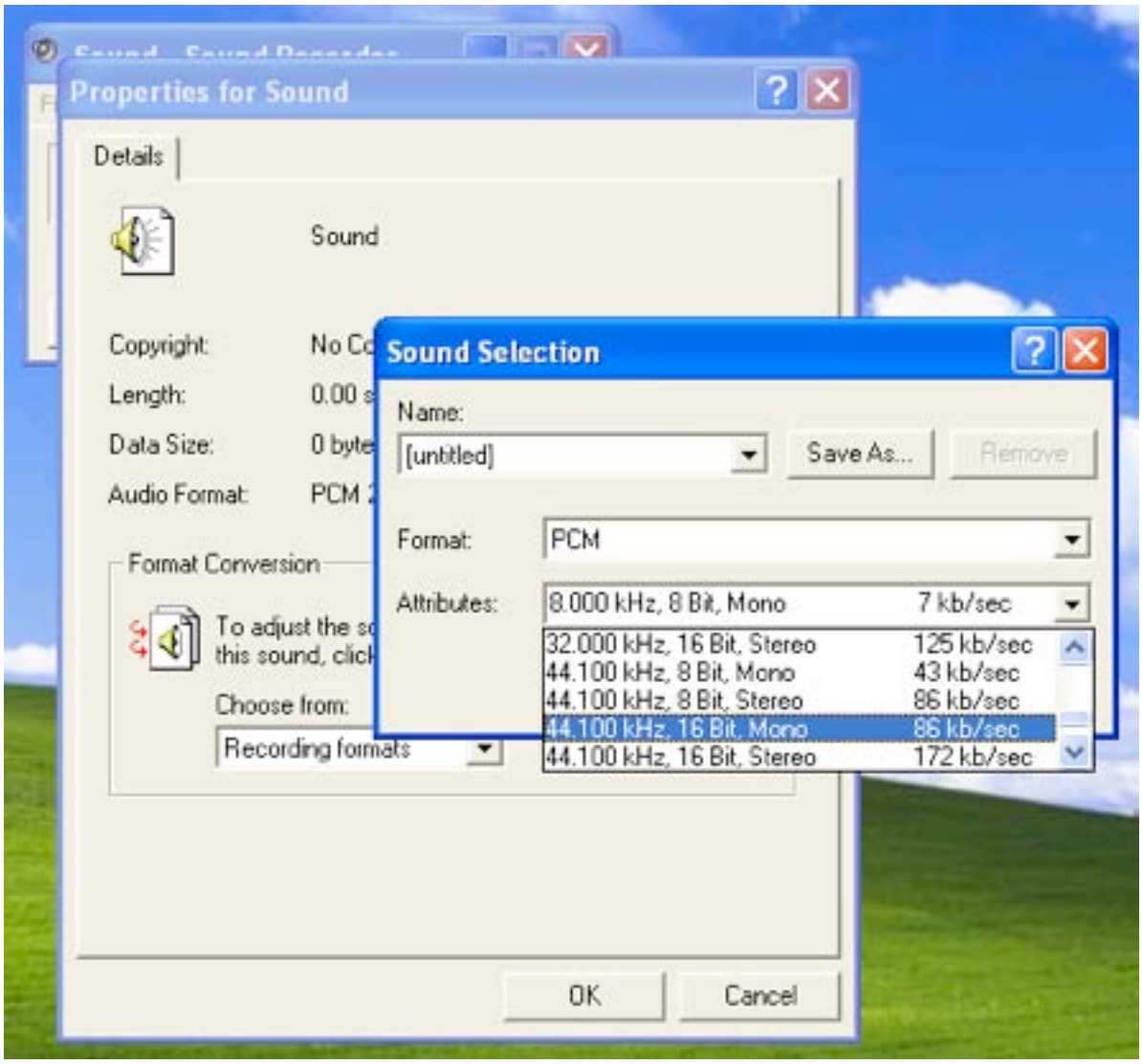
Microphone Input level too low, distortion or audio device not supported (Windows)

In the control panel choose “Sounds and Audio Devices.” Click on the Audio tab. Under Sound recording set the volume for the microphone to the maximum.



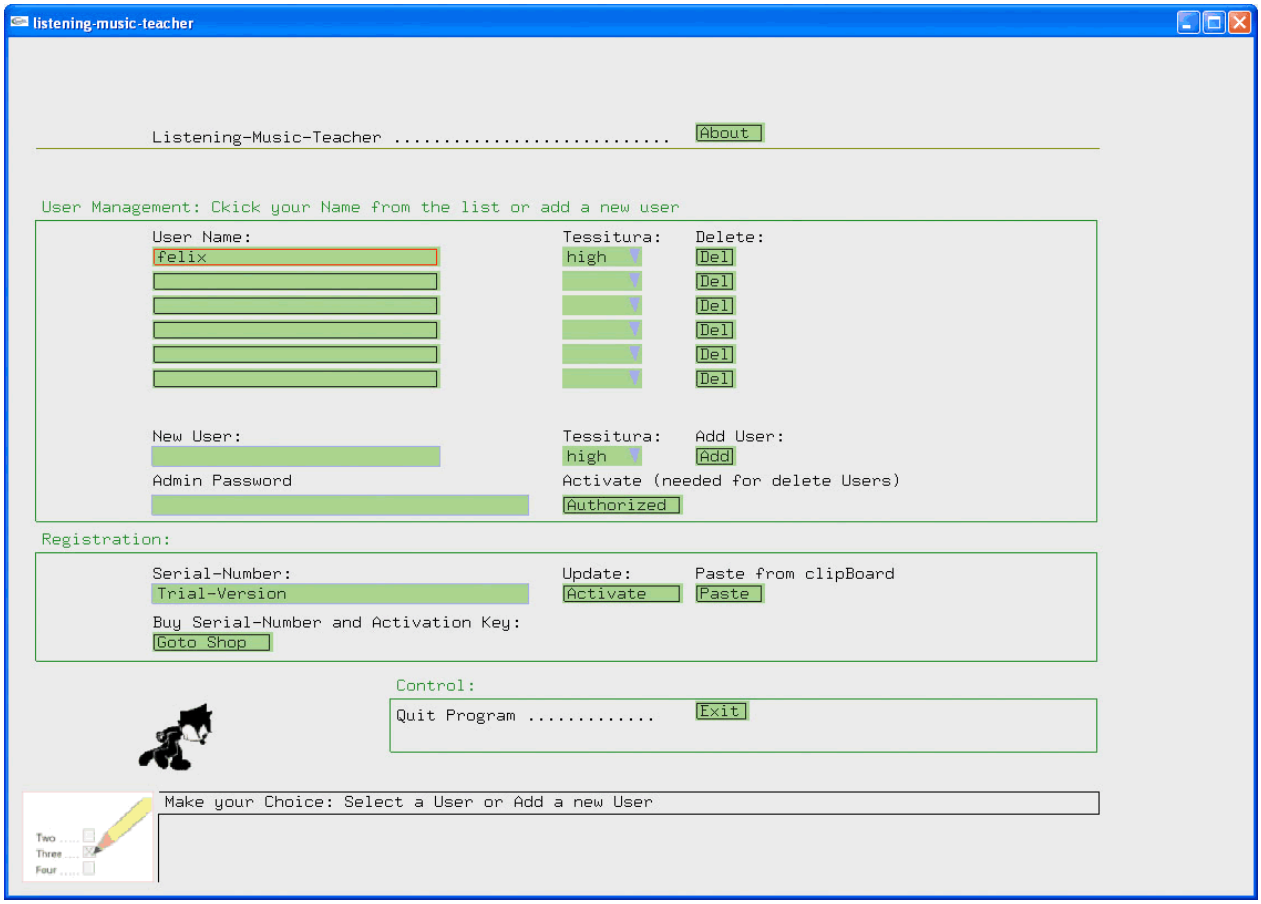
Also make sure that the Format is set to 44.100 kHz and 16 Bit Mono. Make a Test Recording with the “Sound Recorder” (Click On “Start” --> “All Programs” --> “Accessories” --> “Entertainment” --> “Sound Recorder”).

In the Sound Recorder, under the “File” menu, click on “Properties.” Under “Choose from” select “Recording formats” and click “Convert Now.” Set the Format to PCM and select “44.100 kHz 16 Bit, Mono.”


Properties for Sound
Details
Sound
Copyright:
Length:
Data Size:
Audio Format:
Format Conversion
Choose from:
Recording formats
OK
Cancel
Sound Selection
Name:
[untitled]
Save As...
Remove
Format:
PCM
Attributes:
8.000 kHz, 8 Bit, Mono 7 kb/sec
32.000 kHz, 16 Bit, Stereo 125 kb/sec
44.100 kHz, 8 Bit, Mono 43 kb/sec
44.100 kHz, 8 Bit, Stereo 86 kb/sec
44.100 kHz, 16 Bit, Mono 86 kb/sec
44.100 kHz, 16 Bit, Stereo 172 kb/sec

Registration

The fields for registration are in the “User Select” dialog box in the Registration frame.



The fields of the Registration frame are defined below:

- Serial Number:
  Here you can enter a serial number manually. Normally you do not have to enter a number here, since during the ordering process the serial number will be entered automatically. If you reinstall, you must enter the serial number again. We recommend that you paste the serial number from the order-confirmation email with the button labeled “Paste.”
- Update:
  This button reads either “Activate” or “Deactivate.” If the product is not registered, you must go through an activation process by entering the serial number and then pressing “Activate.” The activation process requires an active Internet connection. If the Button reads “Deactivate” then the product is registered. Deactivation may allow you to transfer the program to another computer. However, be aware that no warranty guarantees this process functions (e. g. the other computer may have a unsupported OS. see License terms).

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